SIEMENS

# SIMODRIVE 611 universal and POSMO A

## General Motion Control Catalog
## Part 3 · 2001

MOTION CONTROL

## Catalogs of the General Motion Control Series

**General Motion Control Catalog Part 1**

SIMOVERT MASTERDRIVES MC
0.75 HP to 270 HP

Order No.: DRSP-02060

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**General Motion Control Catalog Part 2**

High Performance
Motors and Accessories

Order No.: DRSP-02062

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**General Motion Control Catalog Part 3**

SIMODRIVE 611 universal
POSMO A
Single-Motor and Multi-Motor Drives
1.5 to 160 HP

Order No.: DRSP-02080

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SIEMENS

# SIMODRIVE 611 universal

# POSMO A

## Single-Motor and Multi-Motor Drives 1.5 HP to 160 HP (1.1 kW to 120 kW)

General Motion Control
Catalog Part 3 · 2001

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• The technical data, selection and ordering data (order numbers), accessories and availability are subject to alteration.

**Warning!**

The technical data are intended for general information.
Please observe the operating instructions and the references indicated on the products for installation, operation and maintenance.

**Trademarks TM**

MICROMASTER, COMBIMASTER, SIMATIC, SIMATIC HMI, SIMODRIVE, SIMOLINK, SIMOREG, SIMOVERT, SITOP and STEP are Siemens registered trademarks.
All other products and system names in this catalog are (registered) trademarks of their respective owners and must be treated accordingly.

• All dimensions in this catalog are stated in inches (mm).

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# SIMODRIVE 611 universal POSMO A

# Overview

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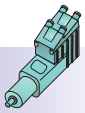
# Overview

## Introduction

SIMODRIVE POSMO A 

SIMODRIVE 611 universal



### A word about Siemens

#### *Siemens AG*

The parent company of Siemens Energy & Automation is Siemens AG, headquartered in Munich, Germany. Various Siemens divisions provide a broad spectrum of products, systems, and services worldwide. These include:
electronic components, medical electronics, power engineering, and automation products and systems, as well as public and private telecommunications networks.

Siemens' worldwide sales exceed $70 Billion in 1999, ranking it among the world's largest electrical companies. Siemens ranks second in manufacturing. Siemens employs approximately 440,000 people in 193 countries, 500 manufacturing facilities in 50 countries on 6 continents. A leading edge company Siemens annually reinvests between 8–1 0% of sales in research and development activities, ranking in the number one position in this category, along with companies like Intel.

#### *Siemens U.S.A.*

The Siemens family of more than twenty companies, subsidiaries, affiliates, and joint ventures in the United States is well established and growing with annual sales in excess of $10.4 Billion. Siemens employs more than 58,000 people in the U.S., in ninety-three domestic manufacturing facilities and more than two-hundred thirty sales and service locations.

#### *Siemens Energy & Automation, inc.*

One of the largest Siemens companies in the U.S. is Siemens Energy & Automation, Inc. with over 9,800 employees and annual sales in excess of $1.9 Billion.

Siemens Energy & Automation is headquartered near Atlanta, Georgia and has 28 U.S. manufacturing facilities. SEA' s facilities throughout the U.S. manufacture, market, and service a wide variety of electrical and electronic equipment and systems that protect, regulate, control, distribute electric power, convert electric power to mechanical energy, and automate various manufacturing and industrial processes. SEA produces 85% of its products domestically, and markets them worldwide.

Siemens Energy & Automation products are sold in two general market segments:
industrial and construction. Our business units are organized into three primary operating divisions:
Industrial Solutions & Software Division,
Distribution Products Division and Industrial Systems & Service.

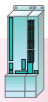
#### *Industrial Solutions & Software Division business unit*

The Solution Business Unit develops, engineers, manufactures, markets, and services adjustable speed drive and automation products. Our adjustable speed drive and automation products are among the finest in the world. Siemens drives have historically offered consistently superior performance and high quality, due to our commitment to continuous improvement in product technologies and production processes.

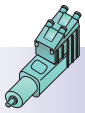
### How the general information is organized

#### *General information*

Welcome to Siemens
The Siemens commitment to customer service
Siemens policies/ protocols
Siemens credit policy
Siemens special handling
Siemens international services
Siemens technical services
Siemens repairs & returns for warranty
Siemens non-warranty repairs
Siemens certified service repairs and returns
Siemens emergency access
Standard terms and conditions of sale



SIMODRIVE 611 universal



SIMODRIVE POSMO A

Customer service

## Welcome to Siemens

If you are a new Siemens Drive Products customer, we thank you for doing business with us. We will work hard to earn your trust and serve your company as if it were our own! If you are currently doing business with us, we thank you for the opportunity to grow with you.

Based on the principle, "One Call Does It All," we have brought several functions into one operating group. Customer Service Representatives have regional assignments and work closely with local area sales offices, application engineering, engineering, and our technical service group. We believe this will optimize your satisfaction.

It only requires one phone call to access any of the following:

**Order entry**
**Scheduling**
**Spare parts**
**Expediting**
**Repair program**
**Warranty administration**
**Invoicing/billing**
**Contract administration**
**Return goods administration**
**Instruction books**
**Drawings/drawing transmittals**
**Emergency service**
**Claims, disputes, settlements**
**Technical support**

Our overriding concern is your satisfaction. This information has been put together to communicate our policies and procedures as they pertain to our doing business together. If you have any questions or if you wish to discuss any of the items explained in the following pages, please contact your local sales office or the Drive Products Customer Service Center.

In the following pages, we refer to domestic and international products. The definition of these terms is as follows:

Domestic –
Those products which are manufactured and/or inventoried in North America.

International –
Those products which are not inventoried in North America.

As a standard, we are referring to domestic products and spares. If your product or spare does not fall into the domestic category, please see the page marked Siemens International Services.

## The Siemens commitment to customer satisfaction

### *Our customer service objective*

Meet our customers' needs and expectations, and add value to our services through:

1. Prompt, reliable service and information.
2. Availability of key personnel to quickly resolve problems.
3. Effective and efficient utilization of all resources to build a trusting relationship with our customers.

### *Our standards of service*

1. Process quotations within 24-hours with the exception of blanket, international and custom quotations.
2. Enter sales orders within 24-hours of receipt.
3. Return phone calls within one hour of receipt.
4. Make every effort to expedite an order at a customer's request.
5. Issue credit memos within ten days of receipt of material.
6. Issue invoices within 48 hours.

## Siemens policies/protocols

### *Standard Siemens Energy & Automation warranty*

Siemens E&A warrants that on the date of shipment to the Purchaser the goods will be of the kind and quality described in the initial contract, merchantable, and free of defects in workmanship and material.

If within 12 months from date of initial operation, but not more than 18 months from date of shipment by Siemens E&A, of any item of the goods, Purchaser discovers that such item was not as warranted above and promptly notifies Siemens E&A in writing thereof, Siemens E&A shall remedy such defect by, at Siemens E&A option, adjustment, repair or replacement of the item and any affected part of the goods. Purchaser shall assume all responsibility and expense for removal, reinstallation and freight in connection with the foregoing remedy. The same obligations and conditions shall extend to replacement items furnished by Siemens E&A thereunder. Siemens E&A shall have the right of disposal of items replaced by it. Purchaser shall grant Siemens E&A access to the goods at all reasonable times in order for Siemens E&A to determine any defect in the goods. In the event that adjustment, repair or replacement does not remedy the defect, Siemens E&A and Purchaser shall negotiate in good faith an equitable adjustment in the contract price.

Siemens E&A' s responsibility does not extend to any item of the goods which has not been manufactured and sold by Siemens E&A. Such item shall be covered only by the express Warranty, if any, of the manufacturer thereof.

Siemens E&A and its suppliers shall also have no responsibility if the goods have been improperly stored, handled or installed, if the goods have not been operated or maintained according to their ratings or according to instructions in Siemens E&A or supplier furnished manuals, or if unauthorized repairs or modifications have been made to the goods.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES (EXCEPT TITLE, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS, AND CONSTITUTES THE ONLY WARRANTY OF SIEMENS E&A WITH RESPECT TO THE GOODS.).

The foregoing states Purchaser's exclusive remedy against Siemens E&A and the supplier for any defect in the goods or for failure of the goods to be as warranted, whether Purchaser's remedy is based on contract, warranty, failure of such remedy to achieve its essential purpose, tort (including negligence), strict liability, indemnity, or any other legal theory, and whether arising out of warranties, representations, instructions, installations or defects from any cause.

# Overview

## Customer service



### Replacement warranty

Should a remanufactured replacement of a defective item be the solution to a warranty claim, the remanufactured part shall be under warranty for the duration of the warranty of the original item or ninety (90) days, whichever is longer.

A remanufactured part (other than original warranty replacement) carries a ninety (90) day warranty.

### Siemens credit policy

Our terms of payment are Net 30 Days. Invoices are normally sent within 48 hours of shipment of goods.

Credit Memos are processed within three days if there is no dispute of charges. If an invoice is in dispute, our Credit Managers and Customer Service Representatives will work closely with you to resolve the dispute as quickly as possible.

Should any questions or concerns arise regarding your account status, please feel free to contact your local Sales Representative.

### Siemens special handling

#### Freight

All of our original product shipments are F.O.B. point of shipment; freight charges are prepaid and add. All spare parts are shipped freight prepaid and add. For freight charges on International products and parts, please refer to the index for the listing of Siemens International Services.

Orders for customers that require specific freight carriers or copies of freight bills, will be shipped freight collect or third party bill. Freight collect orders are contingent upon freight carrier's acceptance of account's credit.

Customer account number is required for third party billing.

Customers that request proof of delivery and it is proven that the product was received by the customer, will be charged a $50 net fee for each shipment traced.

#### Emergency/expedite fees

We have several special programs in order to meet your needs. It is of course necessary to assess a special fee for these services if the product is not under warranty. These fees are as follows:

NEXT FLIGHT OUT –
Same day delivery for $300. With this service we can receive the order, ship the product and have it delivered in most cases the same day.

NEXT DAY DELIVERY –
$200 if the order is received after 4:00 PM Eastern Standard Time.

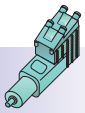
CUSTOMER PICK UP –
There is a two (2) hour processing time. All customer pick ups will be ready 2 hours after order is received, and must be picked up within 24 hours.

In addition to the special handling fees above, the purchaser is responsible for any freight charges associated with these shipments if the item being shipped is not under warranty.

#### Restocking charges

1. Restocking charges apply if you:
   a) Have overstocked and wish to return goods.
   b) Ordered the wrong part.
   c) Initiate a job change.
2. The following charge is now in effect: 10 % for restock of unopened products. 15 % additional charge for repackaging on opened products.
3. If the part has been damaged, a repair cost will be assessed in addition to the above restocking charge.

## SIMODRIVE POSMO A



#### Minimum order

Drive Products has a minimum order policy of $100 for all domestic products and spare part orders. If the order does not total $100 net, an additional fee will be added to bring the total to $100; international orders have a minimum order of $300.

### Siemens international services

Siemens Energy & Automation supports all Siemens Drive Products in the USA, regardless of their country of origin or model type. Certain specialty products are subject to additional logistic requirements. Models in this category are subject to the following special policies.

#### Freight, duty and taxes

The price for international products and spare parts includes freight, duty and taxes.

#### Special fees

The minimum order for international items is $250 net. If the order does not total $250, an additional charge will be added to bring the total order to $250.

Siemens features an international emergency warehouse that can ship many parts within 48 hours. Most products and parts can arrive in the United States within 3–5 days, barring any complications with Customs. Your customer service representative can check to see if your part is in stock in the emergency warehouse. If you order from this warehouse there is a $250 emergency fee. Freight, duty and taxes are still included in the price of the part or parts.

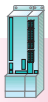
## SIMODRIVE 611 universal

#### International repairs

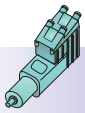
Contact your local Siemens sales office for price & delivery.

#### International warranty

Warranty for international products, spare parts and repairs are covered under the same policy as our domestic products.



SIMODRIVE 611 universal



SIMODRIVE POSMO A

Customer service

## Optional warranties

### *Extended warranty*

Drive Products offers an extended warranty for all products sold. The extended warranty of 12 months is offered with a surcharge of 5% of the net price of the product. This extended warranty offer is only available if ordered prior to time of original shipment from Siemens.

| Months from | Standard warranty | Extended warranty |
|---|---|---|
| installation | 12 | 24 |
| manufacturing | 18 | 30 |
| % of net | 0% | 5% |

### *Deferred warranty*

Siemens also offers a Deferred Warranty for all products sold. Commissioning must also be purchased to inspect the condition of the drive and supervise the drive start up. This deferred warranty offer is only available if ordered prior to time of original shipment from Siemens.

The deferred warranty is offered for those applications that will have a delayed installation period, but only require 12 months from the date of commissioning. The chart below is a listing of the warranty periods and fees for the deferred warranty and the extended warranty programs.

| Months from | Standard warranty | 6 month deferred warranty | 12 month deferred warranty |
|---|---|---|---|
| installation | 12 | 12 | 12 |
| manufacturing | 18 | 24 | 30 |
| % of net | 0% | 1% | 2% |

## Siemens technical services

The Technical Service Group is responsible for technical service support for customers, field service, and sales engineers. Requests for parts, equipment commissioning, emergency service, or routine maintenance are coordinated and scheduled through this group.

Service coordination and technical support for a wide variety of drive products, including both domestic and international supplied units, are available from this team. Interfacing with the Siemens Service Organization, other Siemens Divisions, and supplier service facilities, this group is the single point of contact in effectively providing remote technical and field service support.

Over the past year, an internal survey showed that greater than 95% of the problems called in were resolved over the telephone. This level of technical expertise has significantly reduced the number of on-site service calls.

Technical Service is available 24-hours, 7 days a week by dialing 800-241-4453; ask for Drives Technical Services and the call will be channeled automatically through a call center which activates the appropriate personnel for both parts and technical support.

## Siemens repairs & returns for warranty

It would be wonderful if no board ever failed or every shipment was perfect. However, there are times when you must return a part for repair or replacement. Following, please find the steps you need to take in order to return a defective part to Siemens Energy & Automation.

Please make sure to follow these instructions. Parts sent back to Siemens E&A not using the procedures outlined below may cause your warranty to be voided or improper credit to be issued.

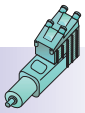
### *Defective part*

1. Call – 800-241-4453 and ask for Drives Technical Service, or you may wish to send a fax with the following information to 770-740-3396.
   a) Company Name
   b) Part Number(s) of item(s) you wish to return
   c) Serial Number and Model Number
   d) Original P.O. Number or Siemens E&A Sales Order Number, Reason for Return (failure symptom if applicable).
2. If you have an emergency, e.g. your equipment is down, and the warranty can be validated commercially, i.e., the shipping or installation date falls within the warranty period, we will ship a replacement part to you next day air or next flight out at no charge conditional on a technical validation of the warranty once the defective item is received in our repair department. Please note, however, that a conditional 30-day purchase order for warranty replacement is required prior to shipment of any part. Should you fail to return the defective part within thirty (30) days upon instructions from your Sales or Customer Service Representative, you will be invoiced in full for the replacement part.

# Overview

## Customer service





3. If you are not in an emergency situation, once we have received and inspected the defective part and validated the technical warranty, we will repair and return your original product to you at no charge. If the item is unrepairable we will immediately send a replacement at no charge.
4. An RGA (Return Goods Authorization) will be issued to you on the same day you call. Our RGA form has detailed instructions for the proper return of the part to Siemens. You are responsible for freight charges associated with any returned part or parts. Please use anti-static bags when shipping printed circuit boards back to Siemens. If you do not have anti-static bags please let RGA Central know at the time of your initial call and they will provide one. If the boards are received back and they do not have the proper protection from static, the warranty is null and void. Any item received without an RGA number will be returned to sender.
5. Our remanufactured parts carry a full ninety (90) day warranty or the remaining period of your original warranty, whichever is longer.

### *Wrong part ordered, shipped, overstock, etc.*

If you have ordered the wrong part, find yourself overstocked, or a wrong part has been shipped to you in error, please follow these procedures:

1. Same as #1 above under Defective Part.
2. An RGA (Return Goods Authorization) number will be issued to you on the same day you call. Our fax form has detailed instructions on how to ship the part back to us. You are responsible for all freight charges associated with any returned parts.
3. Parts should be returned in their original packaging. However, if you have opened the package, please make sure that the parts to be returned are in an anti-static bag, i.e. all boards. (If the board is returned without this protection, the warranty is null and void).
4. Restocking charges – please refer to the restocking charges under Special Handling Charges.
   Restocking charges will apply only if the return is not Siemens responsibility, i.e., wrong part ordered, overstock, exchange, etc. If the part has been damaged, a repair cost will be assessed in addition to the restocking charge.

**Please note that according to our standard terms and conditions, all claims for incorrect items shipped must be made within thirty (30) days after receipt of shipment.**

### Siemens non-warranty repairs

If you have a repair that is non-warranty, please contact your local distributor or simply call 800-241-4453.

Siemens will fax an RGA form with instructions on how to send the item in for repair and return.

### Siemens certified service repairs and returns

If your warranty has expired, you may still want to take advantage of our excellent repair and return program. Highly trained technicians perform incoming tests to determine the exact failure, repair the equipment, and fully test prior to shipment back to you.

However, if you elect, in some instances, we may be able to send you a remanufactured part for 60% of the list price of a new part less your applicable discount on an exchange basis. Remanufactured parts carry a ninety (90) day warranty. Your sales or customer service representative can tell you which parts are included in our repair/return program.

Should you take advantage of this program, please note that if you fail to return the original part to us within ten (10) days, you will be invoiced for the balance of a new board, which is 40%.

Of course, you can always purchase a new part at your option!

If you have an emergency and you are down, we have two excellent emergency programs.

(Please note – expedite fees do not apply to parts under warranty):

1. NEXT FLIGHT OUT –
   Most of our products and spare parts can be shipped from our Emergency Depot located at Atlanta Hartsfield International Airport. These parts go next flight out and for most areas of the country are received the same day. There is a $300 expedite charge for this service plus any freight charges associated with the shipment.
2. NEXT DAY AIR –
   You will receive your part the following day, depending on the location of the ship-to address. There is a $200 expedite charge for this service plus any freight charges associated with the order, if the order is received at our office after 4:00 PM Eastern Standard Time.

### Siemens emergency access

The Drive Products Business Unit has an emergency spare parts depot at Atlanta Hartsfield International Airport. Same day delivery requirements are often serviced out of this Depot as well as after hour shipments including weekends and holidays. This has allowed us to expedite emergency shipment, saving several hours in the process.

To activate our Emergency/After Hours Service, simply dial 800-241-4453 and ask for Drives Technical Service and the call will be automatically transferred to our message service, who will in turn page the On-Call Representative.

Tell the operator there is an emergency and you would like to contact after hour's personnel for spare parts or technical service, and we will return your call immediately.

### *Technical assistance*

When the Technical Service Department, which is responsible for technical support, is unavailable, a reliable answering service ensures that a technical service request is relayed immediately to one of our engineers on call. Should you need technical assistance (other than ordering a part) **please call 1-800-241-4453; this toll free number provides day and night access to our Corporate Field Service Organization.**

## Standard terms and conditions of sale (1/1/2000)

**Siemens Energy & Automation, Inc. ("Seller")**

1. **WARRANTY** -
   (a) Seller warrants that on the date of shipment the goods are of the kind and quality described herein and are free of non-conformities in workmanship and material. This warranty does not apply to goods delivered by Seller but manufactured by others.

   (b) Buyer's exclusive remedy for a nonconformity in any item of the goods shall be the repair or the replacement (at Seller's option) of the item and any affected part of the goods. Seller's obligation to repair or replace shall be in effect for a period of one (1) year from initial operation of the goods but not more than eighteen (18) months from Seller's shipment of the goods, provided Buyer has sent written notice within that period of time to Seller that the goods do not conform to the above warranty. Repaired and replacement parts shall be warranted for the remainder of the original period of notification set forth above, but in no event less than 12 months from repair or replacement. At its expense, Buyer shall remove and ship to Seller any such nonconforming items and shall reinstall the repaired or replaced parts. Buyer shall grant Seller access to the goods at all reasonable times in order for Seller to determine any nonconformity in the goods. Seller shall have the right of disposal of items replaced by it. If Seller is unable or unwilling to repair or replace, or if repair or replacement does not remedy the nonconformity, Seller and Buyer shall negotiate an equitable adjustment in the contract price, which may include a full refund of the contract price for the nonconforming goods.

   (c) SELLER HEREBY DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, EXCEPT THAT OF TITLE. SPECIFICALLY, IT DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, COURSE OF DEALING AND USAGE OF TRADE.

   (d) Buyer and successors of Buyer are limited to the remedies specified in this article and shall have no others for a nonconformity in the goods. Buyer agrees that these remedies provide Buyer and its successors with a minimum adequate remedy and are their exclusive remedies, whether Buyer's or its successors' remedies are based on contract, warranty, tort (including negligence), strict liability, indemnity, or any other legal theory, and whether arising out of warranties, representations, instructions, installations, or nonconformities from any cause.

   (e) Note: This article 1 does not apply to any software which may be furnished by Seller. In such cases, the attached Software License Addendum applies.

2. **PATENTS** - Seller shall pay costs and damages finally awarded in any suit against Buyer or its vendees to the extent based upon a finding that the design or construction of the goods as furnished infringes a United States patent (except infringement occurring as a result of incorporating a design or modification at Buyer's request), provided that Buyer promptly notifies Seller of any charge of infringement, and Seller is given the right at its expense to settle such charge and to defend or control the defense of any suit based upon such charge. Seller shall have no obligation hereunder with respect to claims, suits or proceedings, resulting from or related to, in whole or in part, (i) the use of software or software documentation, (ii) compliance with Buyer's specifications, (iii) the combination with, or modification of, the goods after delivery by Seller, or (iv) the use of the goods, or any part thereof, in the practice of a process. THIS ARTICLE SETS FORTH SELLER'S ENTIRE LIABILITY WITH RESPECT TO PATENTS.

3. **PERFORMANCE; DELAYS** - Timely performance by Seller is contingent upon Buyer's supplying to Seller, when needed, all required technical information and data, including drawing approvals, and all required commercial documentation. If Seller suffers delay in performance due to any cause beyond its reasonable control, the time of performance shall be extended a period of time equal to the period of the delay and its consequences. Seller will give to Buyer notice within a reasonable time after Seller becomes aware of any such delay.

4. **SHIPMENT, TITLE AND RISK OF LOSS** -
   (a) The term "shipment" means delivery to the initial carrier in accordance with the delivery terms of this contract. Seller may make partial shipments. Seller shall select method of transportation and route, unless terms are f.o.b point of shipment and Buyer specifies the method and route and is to pay the freight costs in addition to the price. When terms are f.o.b. destination or freight allowed to destination, "destination" means common carrier delivery point (within the United States, excluding Alaska and Hawaii) nearest the destination.

   (b) Title to the goods and risk of loss or damage shall pass to Buyer at the f.o.b. point. Seller shall not be responsible for damage to the goods after having received "in good order" receipts from the carrier.

5. **TAXES** - Any applicable duties or sales, use, excise, value-added or similar taxes will be added to the price and invoiced separately (unless an acceptable exemption certificate is furnished).

6. **TERMS OF PAYMENT** -
   (a) Unless otherwise stated, all payments shall be in United States dollars, and a pro rata payment shall become due as each shipment is made. If shipment is delayed by Buyer, date of notice of readiness for shipment shall be deemed to be date of shipment for payment purposes.

   (b) On late payments, the contract price shall, without prejudice to Seller's right to immediate payment, be increased by 1 1/2% per month on the unpaid balance, but not to exceed the maximum permitted by law.

   (c) If any time in Seller's judgment Buyer is unable or unwilling to meet the terms specified, Seller may require satisfactory assurance or full or partial payment as a condition to commencing or continuing manufacture or making shipment, and may, if shipment has been made, recover the goods from the carrier, pending receipt of such assurances.

7. **NONCANCELLATION** - Buyer may not cancel or terminate for convenience, or direct suspension of manufacture, except with Seller's written consent and then only upon terms that will compensate Seller for its engineering, fabrication and purchasing charges and any other costs relating to such cancellation, termination or suspension, plus a reasonable amount for profit.

8. **NUCLEAR** - Buyer represents and warrants that the goods covered by this contract shall not be used in or in connection with a nuclear facility or application. If Buyer is unable to make such representation and warranty, then Buyer agrees to indemnify and hold harmless Seller and to waive and require its insurers to waive all right of recovery against Seller for any damage, loss, destruction, injury or death resulting from a "nuclear incident", as that term is defined in the Atomic Energy Act of 1954, as amended, whether or not due to Seller's negligence.

9. **LIMITATION OF LIABILITY** - Neither Seller, nor its suppliers shall be liable, whether in contract, warranty, failure of a remedy to achieve its intended or essential purposes, tort (including negligence), strict liability, indemnity or any other legal theory, for loss of use, revenue or profit, or for costs of capital or of substitute use or performance, or for indirect, special, liquidated, incidental or consequential damages, or for any other loss or cost of a similar type, or for claims by Buyer for damages of Buyer's customers. Seller's maximum liability under this contract shall be the contract price. Buyer and Seller agree that the exclusions and limitations set forth in this article are separate and independent from any remedies which Buyer may have hereunder and shall be given full force and effect whether or not any or all such remedies shall be deemed to have failed of their essential purpose.

10. **GOVERNING LAW AND ASSIGNMENT** - The laws of the State of Georgia shall govern the validity, interpretation and enforcement of this contract, without regard to its conflicts of law principles. The application of the United Nations Convention on Contracts for the International Sale of Goods shall be excluded. Assignment may be made only with written consent of both parties; provided, however, Seller may assign to its affiliate without Buyer's consent.

11. **ATTORNEY FEES** - Buyer shall be liable to Seller for any attorney fees and costs incurred by Seller in enforcing any of its rights hereunder.

12. **DISPUTES** - Either party may give the other party written notice of any dispute arising out of or relating to this contract and not resolved in the normal course of business. The parties shall attempt in good faith to resolve such dispute promptly by negotiations between executives who have authority to settle the dispute. If the matter has not been resolved within 60 days of the notice, either party may initiate non-binding mediation of the dispute.

13. **STATUTE OF LIMITATIONS** - To the extent permitted by applicable law, any lawsuit for breach of contract, including breach of warranty, arising out of the transactions covered by this contract, must be commenced not later than twelve (12) months from the date the cause of action accrued.

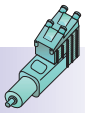
14. **PRICES** - In the event of a price increase or decrease, the price of goods on order will be adjusted to reflect such increase or decrease. This does not apply to a shipment held by request of Buyer. Goods already shipped are not subject to price increase or decrease. Orders on a bid or contract basis are not subject to this article. Orders amounting to less than $100.00 net will be invoiced at $100.00 plus transportation charges for goods covered by discount schedules. Seller's prices include the costs of standard domestic packing only. Any deviation from this standard packing (domestic or export), including U.S. Government sealed packing, will result in extra charges. To determine such extra charges, consult Seller's sales offices.

15. **ADDITIONAL TERMS OF PAYMENT** -
   (a) Invoice payment terms are as shown on latest discount sheets as issued from time to time. Cash discounts are not applicable to notes or trade acceptances, to prepaid transportation charges when added to Seller's invoices or to discountable items if there are undisputed past due items on the account. Portions of an invoice in dispute should be deducted and the balance remitted with a detailed explanation of the deduction. Cash discounts will only be allowed on that portion of the invoice paid within the normal discount period.

   (b) Freight will be allowed to any common-carrier free-delivery point within the United States, excluding Alaska and Hawaii, on shipments exceeding $1,000 net or more providing Seller selects the carrier. On shipments to Alaska and Hawaii, freight will be allowed to dockside at the listed port of debarkation nearest the destination point on shipments of $1,000 net or more. Buyer shall pay all special costs such as cartage, stevedoring and insurance. Special freight allowances are as shown on latest discount sheets as issued from time to time. Cataloged weights are estimated, not guaranteed. Seller assumes no responsibility for tariff classifications on carriers.

16. **CHANGES IN LAWS AND REGULATIONS** - Seller's prices and timely performance are based on all applicable laws, rules, regulations, orders, codes, standards or requirements of governmental authorities effective on the date of Seller's proposal. Any change to any law, rule, regulation, order, code, standard or requirement which requires any change hereunder shall entitle Seller to an equitable adjustment in the prices and any time of performance.

## Features

SIMODRIVE POSMO A 

SIMODRIVE 611 universal

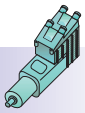
**Comparison between SIMOVERT MASTERDRIVES MC, SIMODRIVE 611 universal and SIMODRIVE POSMO A**

| Feature | SIMOVERT™ MASTERDRIVES MC | SIMODRIVE 611 universal | SIMODRIVE POSMO A |
|---|---|---|---|
| AC – AC | Yes | N/A | N/A |
| DC – AC | Yes | Yes | Yes |
| Output range | 0.75 – 335 HP (0.55 – 250 kW) | 1.5 – 163 HP (1.1 – 120 kW) | 0.1 HP (75 W) |
| Voltage ratings | 380 – 460 V ± 15 % | 400 – 460 V + 6 % – 10 % | 24 V DC ± 20 % |
| Frequency range | 50/60 Hz ± 6 % | 50/60 Hz ± 5 % | N/A |
| Output frequency capability | 0 – 400 Hz | 0 – 1400 Hz | N/A |
| Max. output voltage | 86 % of input voltage (AC)<br>64 % of input voltage (DC) | 86 % of input voltage (AC) | N/A |
| Ambient temperature rating | 104 °F (40 °C) Compact & CHASSIS<br>113 °F (45 °C) Compact PLUS<br>With derating up to 122 °F (50 °C) | 32 °F to 104 °F (0 °C to 40 °C)<br>With derating up to 113 °F (45 °C) | 32 °F to 113 °F (0 °C to 45 °C)<br>With derating up to 149 °F (65 °C) |
| Overload capability | 160 % x Rated output current ($I_n$) for 30 s<br>Cycle time: 300 s<br>or<br>300 % x Rated output current ($I_n$) for 250 ms on Compact PLUS<br>Cycle time: 1 s | 200 % x Rated output current ($I_n$) for 2.65 s<br>Cycle time: 10 s | 200 % x Rated torque for 15 s<br>Cycle time: 60 s |
| Inverter efficiency | 96 – 98 % Compact & CHASSIS<br>93 – 96 % Compact PLUS | 98 % | 65 % |
| Gearboxes | N/A | N/A | Planetary gearbox:<br>– Single stage $i$ = 4.5 and 8<br>– Two stage $i$ = 20.25, 36 and 50<br>– Three stage $i$ = 126.56 and 162<br>Worm Gear:<br>– Single stage $i$ = 5 and 24 |
| Motors which can be connected | SIEMENS synchronous servo motors e.g. 1FT6; 1FK6<br>SIEMENS asynchronous servo motors e.g. 1PH<br>SIEMENS induction motors e.g. 1LA; RGZESDI<br>Standard inverter rated NEMA induction motor | SIEMENS synchronous servo motors e.g. 1FT6; 1FK6<br>SIEMENS asynchronous servo motors e.g. 1PH<br>SIEMENS induction motors e.g. 1LA; RGZESDI<br>SIEMENS linear motors e.g. 1FN | N/A |

**Comparison between SIMOVERT MASTERDRIVES MC, SIMODRIVE 611 universal and SIMODRIVE POSMO A**

| Feature | SIMOVERT MASTERDRIVES MC | SIMODRIVE 611 universal | SIMODRIVE POSMO A |
|---|---|---|---|
| Type of control | | | |
| V/Hz | Standard | Standard | N/A |
| V/Hz w/Slip compensation | N/A | N/A | N/A |
| V/Hz – Textile mode | N/A | N/A | N/A |
| Open loop vector | N/A | N/A | N/A |
| Closed loop speed | Standard | Standard | Standard |
| Torque control | Standard | Standard | N/A |
| Digital inputs/outputs | 2 dedicated inputs (24 V)<br>4 configurable input/output | 4 inputs<br>4 outputs | 2 configurable input/output |
| Analog inputs | (1) ±10 V | (2) ±10 V | N/A |
| Resolution | 10 – BIT + SIGN | 13 – BIT + SIGN | |
| Analog outputs | (1) ±10 V | (2) ±10 V | N/A |
| Resolution | 8 – BIT + SIGN | 7 – BIT + SIGN | |
| Skip frequency | No | Yes | N/A |
| Band stop filter | 1 | 2 | N/A |
| Fixed frequencies | 16 | N/A | N/A |
| Fault memory | Last 8 occurrences (max. 8 faults per occurrence) | Yes | No |
| Warning alarm | Yes | Yes | Yes |
| Motor protection | $I^2t$ protection (PTC/thermistor) | $I^2t$ protection (PTC/thermistor) | $I^2t$ protection |
| Automatic tune | Motor ID, & current loop | Yes | Pre-tuned ex-work |
| Communication types | – USS (standard (2) RS232/485 ports)<br>– Analog (standard)<br>– *PROFIBUS (up to 12 MB) | – standard (2) RS232/485 ports)<br>– Analog (standard)<br>– *PROFIBUS (up to 12 MB) | N/A<br>N/A<br>– PROFIBUS DP up to 12 MB |
| *Optional communication board required | – *SIMOLINK (Peer to Peer/synchronization)<br>– *CAN<br>– *Device net<br>– *CC – link | N/A<br>N/A<br>N/A<br>N/A | N/A<br>N/A<br>N/A<br>N/A |
| Carrier frequency | 5 – 8 kHz<br>5 – 6 kHz (with technology option) | 2 – 8 kHz<br>3.2 kHz recommended for induction motors<br>4.0 kHz recommended for synchronous motors | N/A |
| PID control | Yes – full function | N/A | N/A |
| Braking capability | Optional pulse resistor braking or regenerative (brake chopper integrated in AC – AC Compact PLUS units | Optional pulse resistor braking or regenerative (holding braking management integrated)<br>Built-in resistor for 6.5 and 13.5 HP (5 and 10 kW)<br>O/I modules | Optional external Power Management Module |

## Features

SIMODRIVE POSMO A 

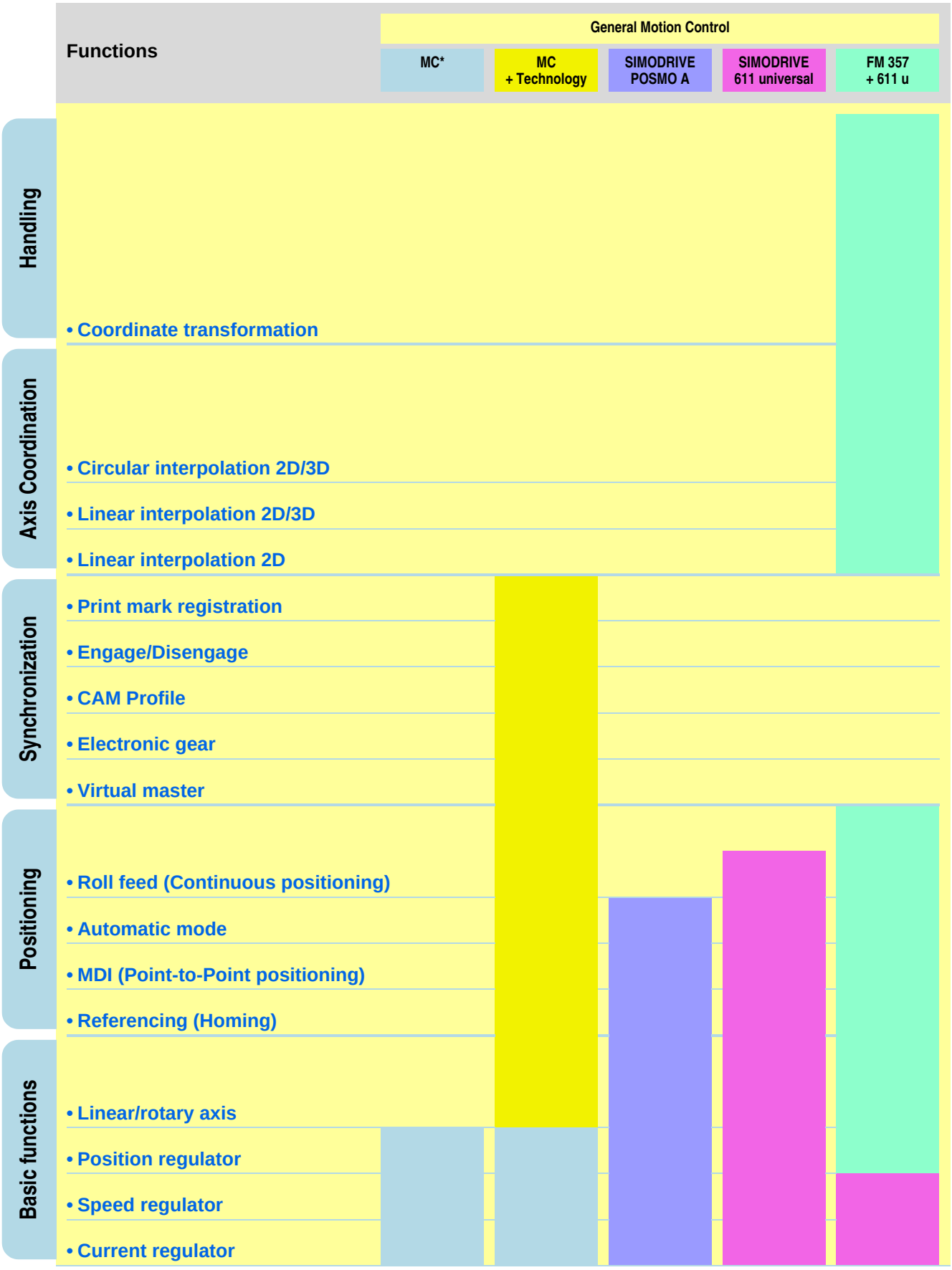
SIMODRIVE 611 universal



**Comparison between SIMOVERT MASTERDRIVES MC, SIMODRIVE 611 universal and SIMODRIVE POSMO A**

| Feature | SIMOVERT MASTERDRIVES MC | SIMODRIVE 611 universal | SIMODRIVE POSMO A |
|---|---|---|---|
| "S" Curve acceleration | Yes with comfort ramp-function generator (free function block) | Yes | Ramp up time setting |
| Hoist brake interface | Standard | Standard | N/A |
| Standard keypad | 6-button,<br>4-digit, 7-segment red LED's<br>3-button on compact PLUS unit | 3-button,<br>6-digit, 7-segment | N/A |
| Optional keypad | LCD multi-language text display<br>BUS master/direct parameter access<br>Parameter storage | N/A | N/A |
| Firmware upgrade via flash $e^2$prom | Standard | Standard | N/A |
| Field-weakening operation range for induction motors | 1 : 2 | 1 : 16 | N/A |
| Position control | With technology option | Yes | Yes |
| Electronic line shaft via fiberoptic cable | Yes<br>(using SIMOLINK) | N/A | N/A |
| Positioning update time<br>Current update time<br>Speed update time | 1.6 ms<br>0.2 ms<br>0.4 ms | 1 ms<br>31.5 $\mu$s<br>0.25 ms | 10 ms<br>125 $\mu$s<br>1 ms |
| Agency compliance | UL listed, CSA, CE | UL listed, CSA, CE | UL listed, CE |
| Application<br>Examples/guidelines | Electronic line shaft<br>Web handling w/synchronization<br>Point to point positioning<br>Cut-to-length applications | Point to point positioning<br>Search for reference<br>Automatic positioning | Positioning of formats or end stop<br>Positioning of process variables (e.g. by means of motorized valves) |

**Selection guideline for Siemens, non-machine tool, motion control solutions**




* Simple positioning with V 1.5 and greater.

# Overview

## Application

### SIMODRIVE 611 universal

With a proven hardware platform in the machine tool industry, the new 611 U (U for "Universal") has been designed to handle a range of General Motion Control applications. Capable of controlling various motor types, be it Synchronous Servo, Asynchronous Servo, standard Induction or Linear. Its compact multi-axis design is well suited for many industries – i.e. printing, packaging, textile, wood, glass, etc.

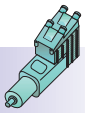
The SIMODRIVE 611 universal is supplied for line voltages of 3-phase 380 V to 480 V AC, 50/60 Hz and is available from 1.5 HP to 160 HP (1.1 to 120 kW). The modules have a standard design of 19 inches (480 mm) high by 11.5 inches (288 mm) deep and depending on the power range, the width increases in units of 2 inches (50 mm).

Some of the main features of the SIMODRIVE 611 universal are as follows:

- configurable for speed/torque control and positioning control
- suitable for synchronous and induction motors
- compact design with 1-axis and 2-axis modules
- communication with PROFIBUS
- and all data in the package present on a transferable memory submodule

In addition to classical drive functions such as torque and speed control with output frequencies up to 1400 Hz, SIMODRIVE 611 U offers integral positioning functions.

### SIMODRIVE POSMO A



Up to 64 independent traversing blocks can be stored to perform either absolute or relative position moves allowing it to be characterized by

- extremely high dynamic performance
- flexible positioning
- high field weakening range
- and ease of use.

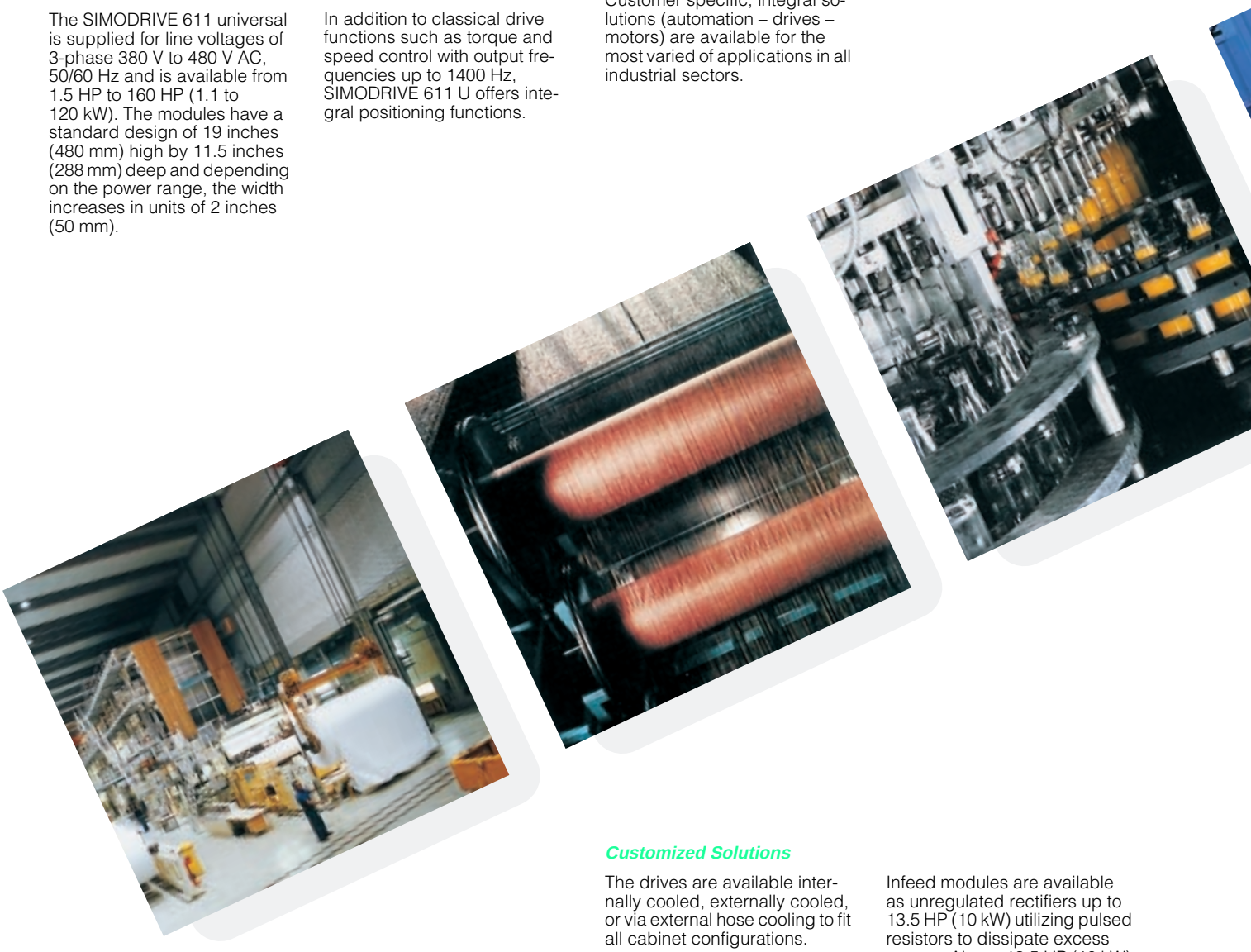
The program is rounded off by a complete spectrum of system components and accessories.

Customer specific, integral solutions (automation – drives – motors) are available for the most varied of applications in all industrial sectors.

### SIMODRIVE 611 universal

For the SIMODRIVE 611 universal, an easy to use Windows based graphical programming and diagnostic tool is available. Known as SIMOCOM U, this tool has been specially developed to make start up of the drive system effortless.

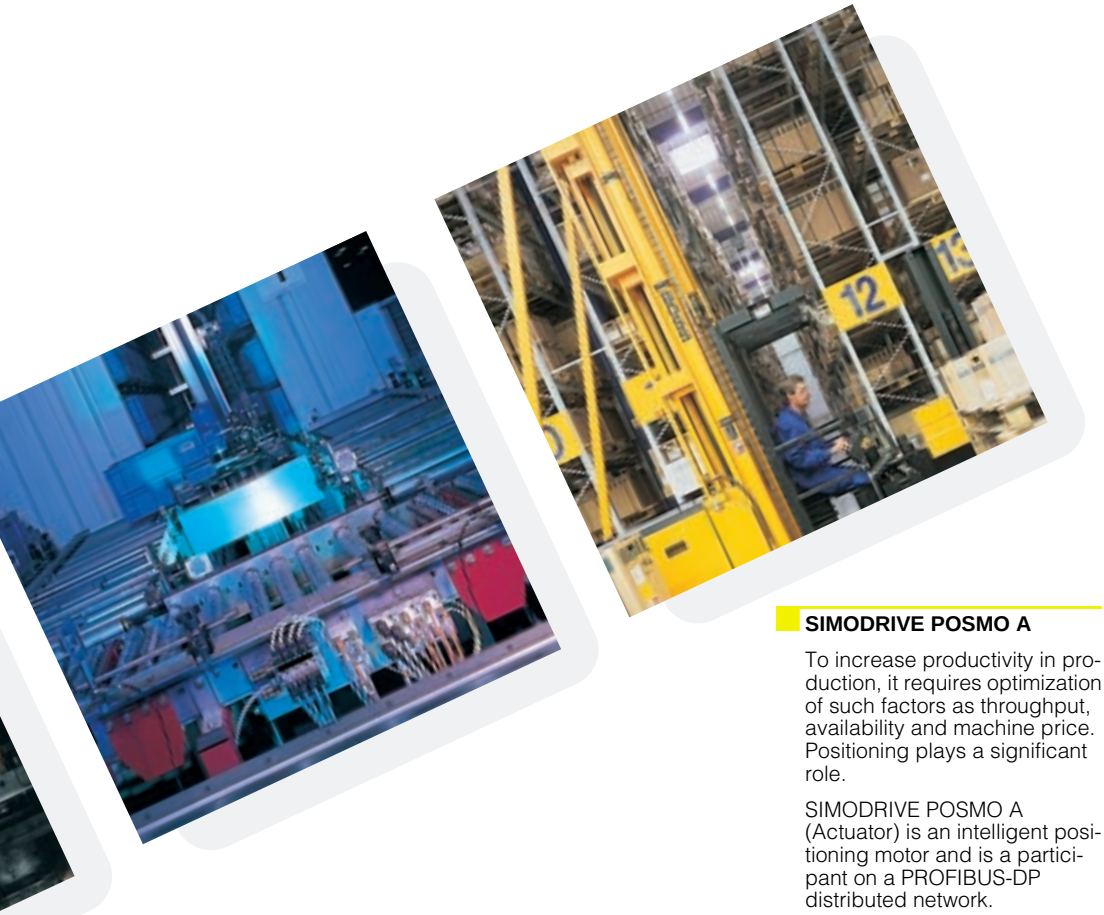
Siemens' world-wide service and the company's sales network enable all our customers to obtain direct access to expert advice and project planning as well as training and service.



### *Customized Solutions*

The drives are available internally cooled, externally cooled, or via external hose cooling to fit all cabinet configurations.

Infeed modules are available as unregulated rectifiers up to 13.5 HP (10 kW) utilizing pulsed resistors to dissipate excess energy. Above 13.5 HP (10 kW) regulated regenerative units are utilized to return excess energy to the supply.



## SIMODRIVE POSMO A

To increase productivity in production, it requires optimization of such factors as throughput, availability and machine price. Positioning plays a significant role.

SIMODRIVE POSMO A (Actuator) is an intelligent positioning motor and is a participant on a PROFIBUS-DP distributed network.

Main features:

- Power section and entire movement control in the motor
- Linking via communication and power bus
- PROFIBUS-DP standard slave

With its well designed distributed concept, SIMODRIVE POSMO A opens up a new level in automation.

Typical applications are the:

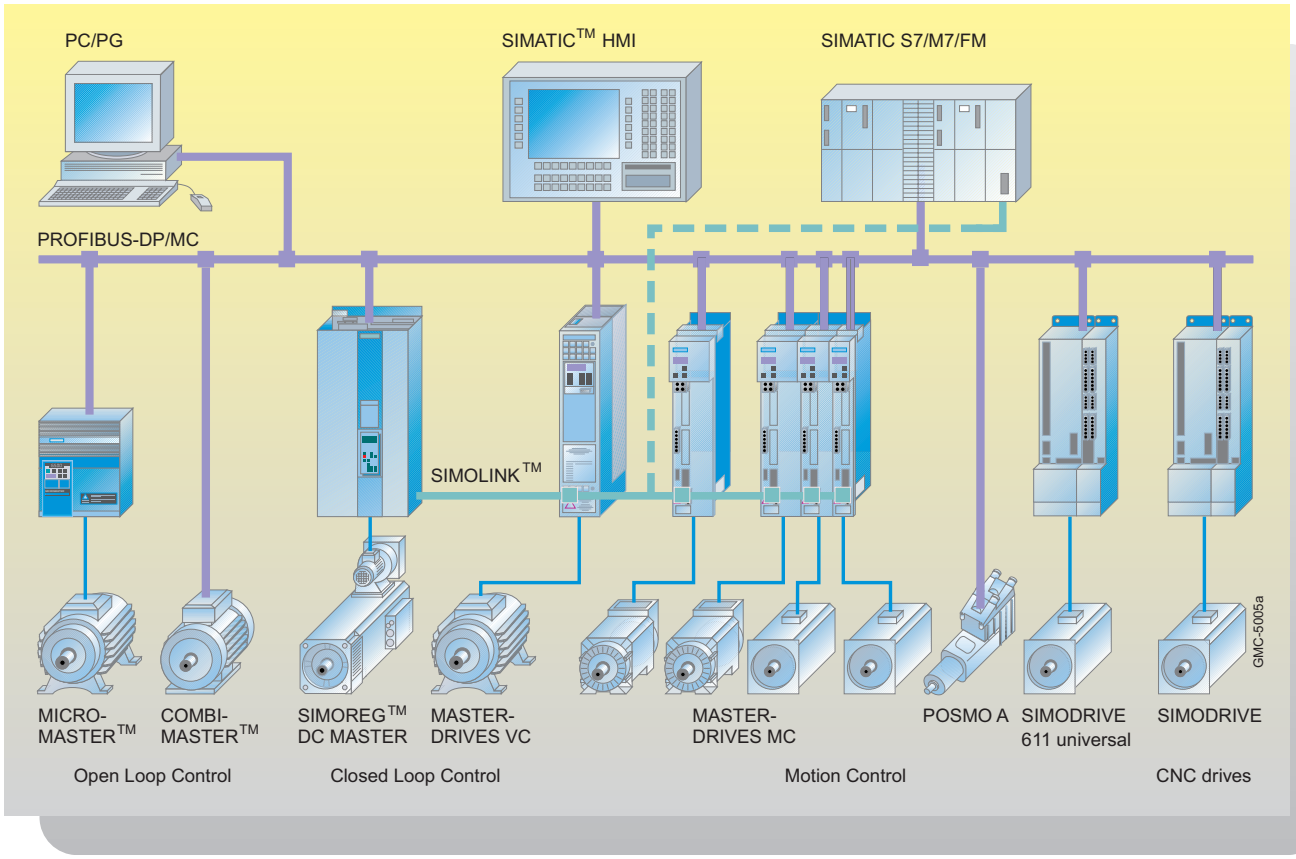
- Adjustment of formats or end stops
- Setting of process variables, for example via motorized valves

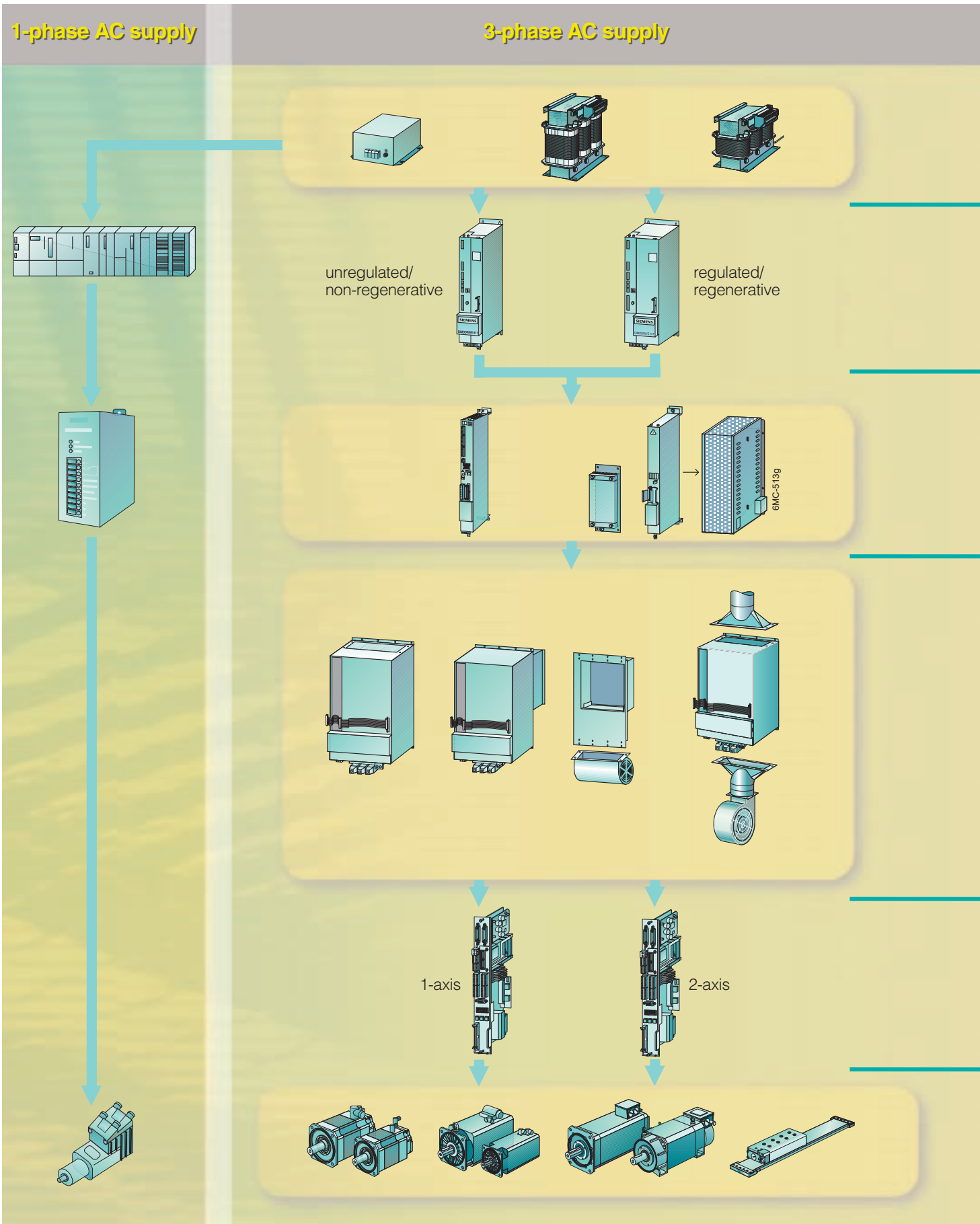
Improved production costs:

Lower engineering costs can be achieved through the distributed drive architecture. Production time can be improved due to short set-up times and automated process variable settings through intelligent movement control.

SIMODRIVE POSMO A functions well in machines for packaging, wood, glass, printing, plastics, and transfer lines. They are also used in medical diagnostics for moving table tops or X-ray equipment.

***Optimal integration of drives into the world of automation***



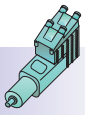

1-phase AC supply
3-phase AC supply
unregulated/
non-regenerative
regulated/
regenerative
6MC-513g
1-axis
2-axis

| | Technical data<br>Page | Selection and ordering data<br>Page | Engineering information<br>Page | Dimension drawings<br>Page |
|---|---|---|---|---|
| **Line-side components** | | | | |
| Commutating reactors | 2/6 | 3/10 | 6/27 | 7/5 |
| Mains filters | 2/6 | 3/10 | 6/28 | 7/5 |
| Mains filter package | – | 3/10 | 6/29 | – |
| Overvoltage limiter module | 2/6 | 3/5 | 6/29, 6/53 | – |
| **Infeed modules** | | | | |
| Rectifier and rectifier/ regenerative unit | 2/3 | 3/2 | 6/30, 6/31, 6/47, 6/51, 6/52 | 7/6, 7/9 |
| **SITOP Power supply** | 2/9 | 3/16 | 6/73 | – |
| **System components** | | | | |
| Monitoring module | 2/6 | 3/5 | 6/33, 6/60 | 7/2 |
| Pulse resistor module | 2/5 | 3/5 | 6/34, 6/35 | 7/3 |
| Power Management Module | 2/9 | 3/15 | 6/75 | – |
| **Power sections** | | | | |
| Power modules | 2/4 | 3/3 | 6/31, 6/49, 6/50 | 7/2 |
| Power modules internally cooled | 2/4 | 3/3 | 6/31 | 7/2 |
| Power modules externally cooled | 2/4 | 3/3 | 6/37 | 7/9 – 7/13 |
| Power modules host cooled | – | 3/3 | 6/38 | 7/7, 7/8 |
| **Electronic options** | | | | |
| Plug-in units | – | – | 6/32, 6/53 – 6/59 | – |
| **Interconnecting components** | | | | |
| Power cables | 2/10 | 3/13 | – | – |
| Power and encoder cables | 2/10 | 6/63, 6/64 | 6/63, 6/64 | – |
| PROFIBUS cables and connectors | 2/11, 2/12 | 3/13, 3/14 | – | – |
| **Motors** | | | | |
| POSMO A | 2/7 | 3/13 | 3/12, 6/73 – 6/86 | 7/16 |
| 1FK6 and 1FT6 synchronous motors, 1PH7, 1PL6 and 1PH4 compact induction motors, 1FN3 linear motors | | | see Siemens General Motion Control Catalog, Part 2 | |

# Overview

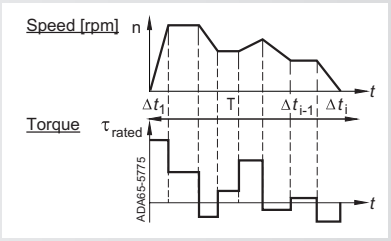
## Flow diagram for SIMODRIVE 611 universal selection process

SIMODRIVE POSMO A



SIMODRIVE 611 universal

**Mandatory information**




It is necessary to know the specific speed and load cycle of your application in order to select a proper drive and motor.

**Step 1**

**Determine degree of protection:**
IP 23; IP 55; IP 64; IP 65; IP 67 — see section 7 for details

**Step 2**

**Determine supply voltage:**
380 to 400 V; 460 to 480 V

**Step 3**

**Determine type of construction:** — see section 7 for details
IM B 3 (foot mounting); IM B 5 (flange mounting); IM B 35 (foot/flange mounting)

**Step 4**

**Determine maximum torque from load cycle profile:**

**Step 5**

**Determine mean (RMS) torque:**
see section 7 for calculation

**Step 6**

**Determine type of motor needed (synchronous/asynchronous):**
1FK6; 1FT6; 1PH7; 1PL6; 1PH4; 1FN3 — see overview in section 1

**Step 7**

**Select motor from appropriate data page (section 2 or 3) that fulfill the following criteria**

Synchronous motors:
$n_{max} \leq n_{rated}$
$\tau_{RMS} \leq \tau_{rated}$
Points of cycle ($n_i$, $\tau_i$) must be in intermittent operating region see graphs in section 7.

Asynchronous motors:
$n_{max} \leq n_{rated}$; $\tau_{max} < 2 \times \tau_{rated}$
$\tau_{RMS} \leq \tau_{rated}$
Points of load ($n_i$, $\tau_i$) must be below breakdown torque curve by a minimum clearance of 30 %. See section 7.

**Step 8**

**Determine the kind of feedback device required:** — see section 4 for details
Pulse encoder (only induction motor); resolver; sin/cos encoder; absolute value encoder

**Step 9**

**Complete motor part number based on options required:**
1FK6; 1FT6;1PH7; 1PL6; 1PH4; 1FN3 — see section 2 or 3 for details

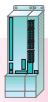
**Order Number Motor:**
**1FK6** □□□-□□□□□-□□□□
**1FT6** □□□-□□□□□-□□□□
**1PH7** □□□-□□□□□-□□□□
**1PL6** □□□-□□□□□-□□□□
**1PH4** □□□-□□□□□**-Option + codes**
**1FN3** □□□-□□□□□-□□□□

**Step 10**

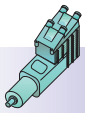
**Determine the length and size of prefabricated power cable required or determine size of coupling for customer assembly:**
see section 5 for details and part number configuration

**Order Number Power Cable:**

**Step 11**



SIMODRIVE 611 universal



SIMODRIVE POSMO A

## Flow diagram for selection process

**Step 11**

**Determine the length and size of prefabricated signal cable required or determine size of coupling for customer assembly:**

a) Resolver
b) Sin/cos encoder
c) Absolute value encoder

see section 5 for details

**Step 12**

**Select Power Module based on calculated motor currents**

see example section 6 for eng. details

**Step 13**

**Choose 1-axis or 2-axis plug-in unit**

With resolver or sin/cos-feedback
speed/torque or position control

see example section 6 for eng. details

**Step 14**

**Repeat step 12 and 13 for all axes of application**

**Step 15**

**Calculate total DC link power $P_{DClink}$**

Planning sheet

see example section 6 for eng. details

**Step 16**

**Check total:**

a) DC link capacitance (charging limit)
b) Power supply rating for 24 V DC

see assessment and configuration sheat section 6 for eng. details

**Step 17**

**Select**

Infeed module based on calculated total DC link power

**Step 18**

**Determine if pulse resistor module and resistor is needed**

Required only for O/I (non regenerative) unit

see section 6 for eng. details

**Step 19**

**Determine if below components are necessary and choose**

a) Appropriate HF commutating reactor
b) Mains filter module according to I/RF (regenerative) rated or O/I (non regenerative) rated power
c) Monitoring modules according electronic points

see section 6 for eng. details

**Step 20**

**Determine if PROFIBUS communication or additional inputs/outputs are required**

**Step 21**

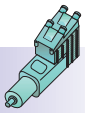
**Select any other additional equipment i.e. bus cable; Two tier module; shield terminal plate etc.**

see section 3 for order details

**Step 22**

**See ordering example in section 6**

Notes



# SIMODRIVE 611 universal POSMO A Technical Data


*SIMODRIVE 611 universal*

2/2 **General technical data**
2/3 Infeed modules
2/4 Power modules
2/5 Braking units and braking resistors
2/6 HF commutating reactors
2/6 Mains filters
2/6 Monitoring module
2/6 Overvoltage limiter module

*SIMODRIVE POSMO A*

2/7 **General technical data**
2/9 SITOP™ 24 V Power supply standard type
2/9 Power management module (PMM)
2/10 Power cable
2/11 Bus connectors
2/12 LAN cables

## General technical data SIMODRIVE 611 universal

SIMODRIVE 611 universal

| | |
|---|---|
| EU low-voltage directive 73/23/EWG and RL 93/68/EWG | EN 50 178 |
| EU-EMC directive 89/336/EWG | EMC product standard EN 55 011 for variable-speed drives |
| EC machine guideline 89/392/EC | Safety category 3 according to Y54-1 |
| Approvals | UL/CSA<br>EN<br>CUL |
| Pollution degree | Pollution degree 2 in accordance with EN 50 178<br>moisture condensation not permissible |
| Overvoltage category | Category III to DIN VDE 0110, Part 2 |
| Degree of protection | To EN 60 529 IP 20[1]) |
| Insulation test voltage | 2.5 kV |
| Shock protection (Impact load) | Acceleration 160.93 ft/s$^2$ (49.05 m/s$^2$) for 11 ms according to EN 60 068-2-27 (IEC 68, Part 2-27) |
| Radio interference<br>• Standard<br>• Options | To EN 61 800-3<br>No radio-interference suppression<br>Radio-interference suppression filter for Class B1 or A1 in accordance with EN 55 011 |
| Vibration stress<br>• Acceleration | To DIN IEC 68-2-6<br>32 ft/s$^2$ (9.8 ms$^{-2}$) in accordance to EN 60 068-2-6 with constant deflection of 0.075 mm in the frequency range 10 Hz to 58 Hz |
| Environmental conditions to DIN EN 60 721-3-3 | Climate 3K5 |
| Cooling type | Forced air cooling with integral fan.<br>Externally cooled by blower or by external duct. |
| Permissible ambient and cooling medium temperature<br>• During operation<br>• During storage and transport | <br>+32 °F to +104 °F (0 °C to 40 °C)[2])<br>–40 °F to 158 °F (–40 °C to +70 °C) |
| Installation altitude | ≤ 3281 ft (1000 m) above sea level |
| Permissible moisture conditions | Relative humidity ≤ 95 % during operation;<br>moisture condensation not permissible |

1) Applicable to power modules only when closed-loop control plug-in units is inserted.

2) With derating to +131 °F (+55 °C).

## Infeed modules

| | Unregulated O/I (aka. U/E) module[1] | Regulated I/RF (aka. I/R) module[2] |
|---|---|---|
| **Rated voltage** Line voltage | 400 V – 10 % to 480 V + 6 % 3-phase AC | |
| Output voltage (DC link voltage) | 490 V to 680 V + 6 % DC | 600 V/625 V 680 V DC selected via switch |
| **Rated frequency** Line frequency | 50 Hz to 60 Hz ± 10 % | |
| Power factor<br>• fundamental<br>• overall | <br>0.87<br>0.67 | <br>0.98<br>0.97 |
| Efficiency | ≈ 0.98 | |

## Infeed modules overload characteristic

### *Rated load duty cycles*

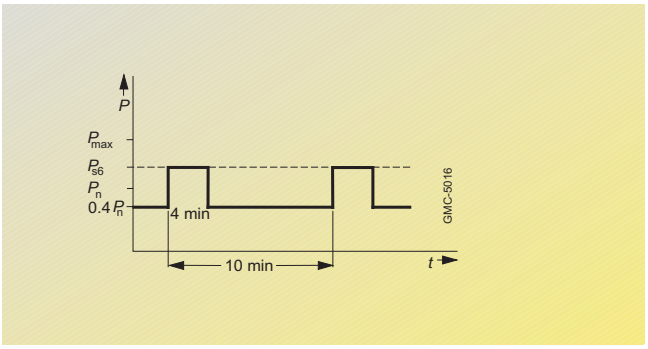



Fig. 2/1
S6 duty cycle with pre-loading condition

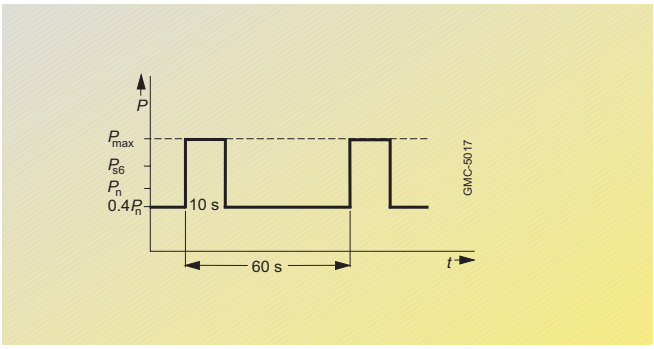



Fig. 2/2
Peak output duty cycle with pre-loading condition

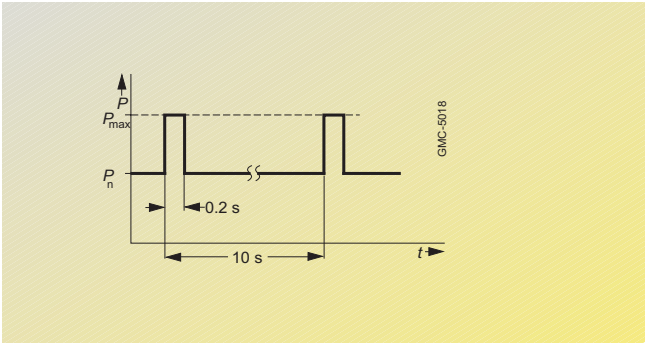



Fig. 2/3
Peak output duty cycle with pre-loading condition

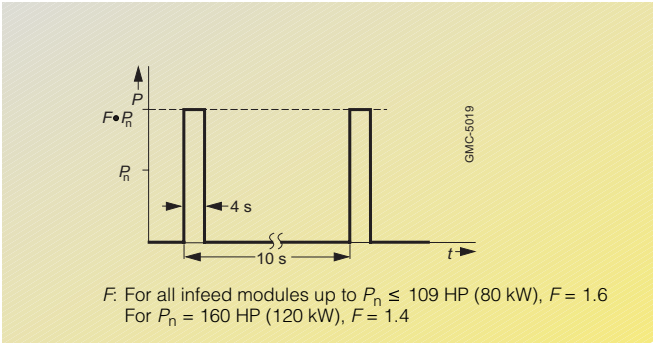
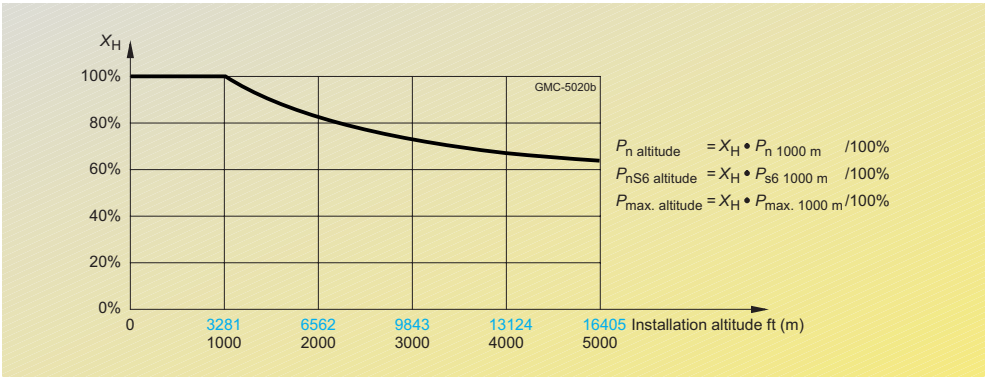



Fig. 2/4
Peak output duty cycle without pre-loading condition

### *Derating as a function of the installation altitude*




**For detailed information see section 6**

Fig. 2/5

1) Unregulated/non regenerative unit

2) Regulated/regenerative unit

## Power modules

| Used with | Unregulated<br>O/I (aka. U/E) module[1]) | Regulated<br>I/RF (aka. I/R) module[2]) |
|---|---|---|
| **Rated voltage**<br>DC link voltage | 490 V DC | 600 V/625 V/680 V DC |
| Output voltage | 0 to 400 V 3-phase AC | 0 to 430 V 3-phase AC |
| **Rated frequency**<br>Output frequency / max. digital resolution | 0 to 1400 Hz | |
| Rated motor output | 1.5 HP to 163 HP (1.1 kW to 120 kW) | |
| **Load class**<br>**Cold start load duty cycle** | | |
| Overload current | 2 x $I_n$ (continuous current) | |
| Overload duration | 2.65 s | |
| Overload cycle time | 10 s | |
| **Load duty cycle** | | |
| Overload current | 2 x $I_n$ (continuous current) | |
| Overload duration | 0.25 s | |
| Overload cycle time | 10 s | |
| Efficiency | 0.98 | |

2

## Power modules, overload characteristic

***Rated load duty cycles***

Typical of synchronous servomotors

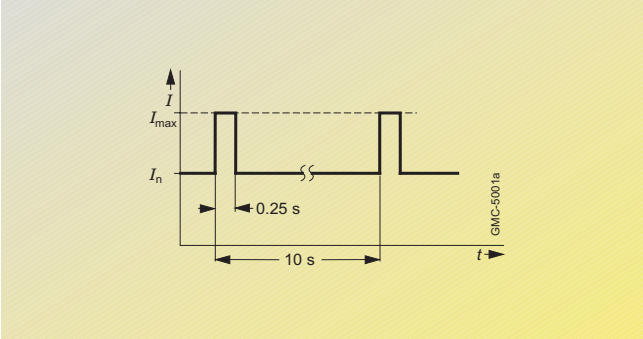



Fig. 2/6
Peak current – load duty cycle with pre-loading condition

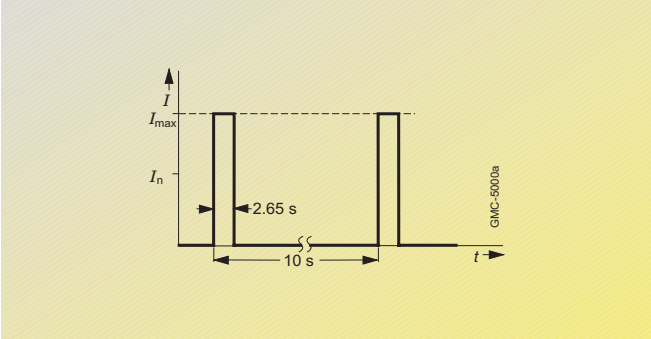



Fig. 2/7
Peak current – load duty cycle without pre-loading condition

Typical of asynchronous servomotors

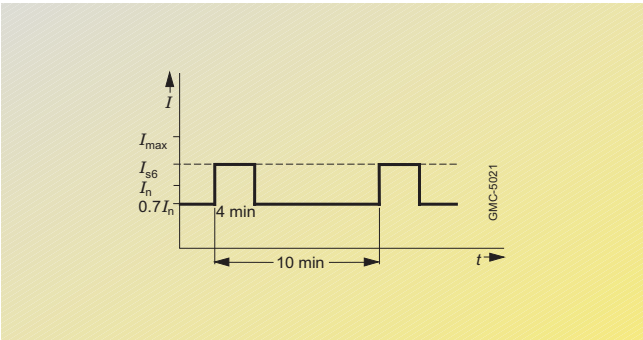



Fig. 2/8
S6 load duty cycle with pre-loading condition

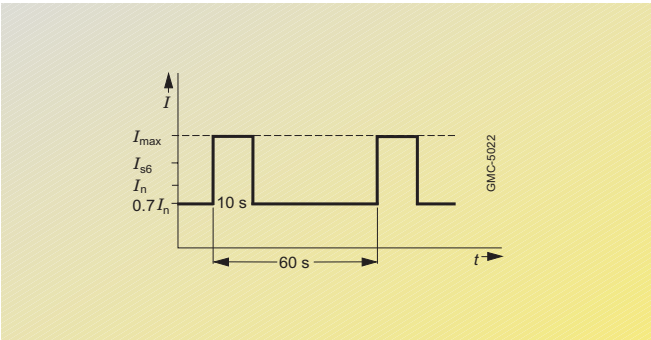



Fig. 2/9
S6 peak current-load duty cycle with pre-loading condition

1) Unregulated/non regenerative unit

2) Regulated/regenerative unit

## Power modules, current reduction curves

### *Current reduction dependent on the inverter clock frequency*

$X1$ = Current reduction factor, current reduction from the inverter clock frequency $f_0$ of the power transistors (refer to the technical data).

$$X = 100\,\% - \frac{(100\,\% - X1) \cdot (f_T - f_0)}{8\,\text{kHz} - f_0}$$

$X$ = the reduction factor obtained [in %] for $I_n$, $I_{S6}$, $I_{max.}$
$f_T$ = selected inverter clock frequency

→ $I_{nf_T}$ = $X \cdot I_{nf_0}/100\,\%$
→ $I_{s6f_T}$ = $X \cdot I_{s6f_0}/100\,\%$
→ $I_{max.f_T}$ = $X \cdot I_{max.f_0}/100\,\%$

**For detailed information see section 6**

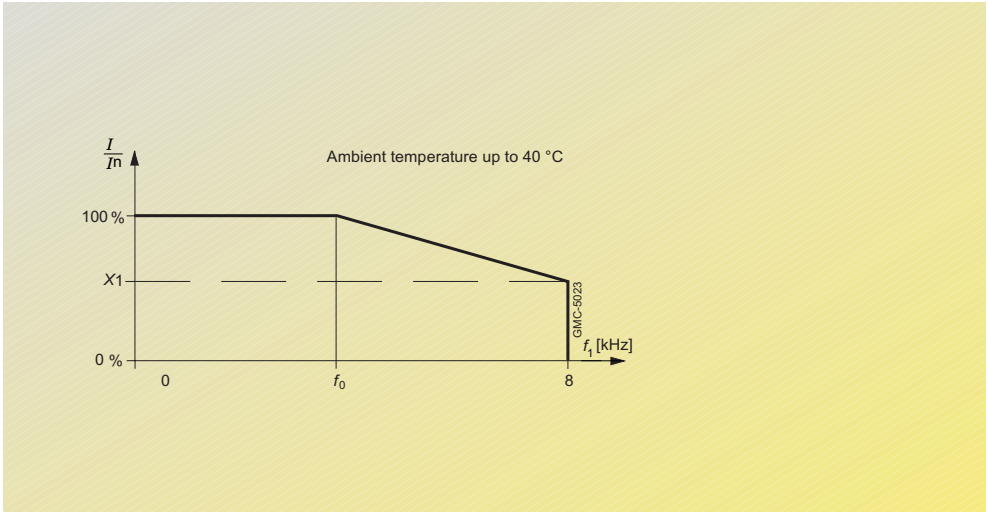



Fig. 2/10

### *Current reduction as a function of the installation altitude*

**For detailed information see section 6**

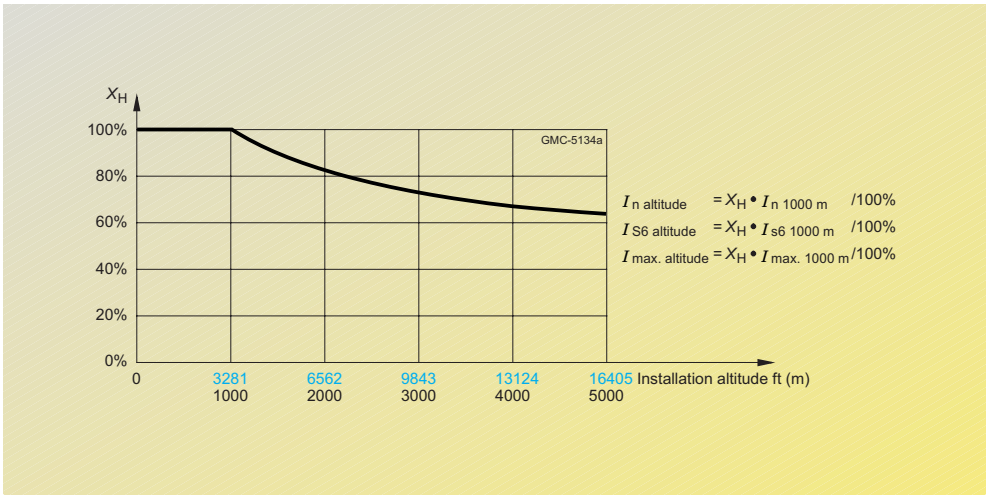



Fig. 2/11

## Braking units and braking resistors

| | External pulsed resistor | Internal pulse resistor |
|---|---|---|
| **Rated voltage**<br>DC link voltage | 600 V/625 V/680 V DC | |
| **Service thresholds**<br>Upper threshold | 644 V/670 V/744 V DC | |
| Lower threshold | 618 V/640 V/718 V DC | |
| **Load class** | | |
| Continuous power $P_D$ | 0.3 kW<br>1.5 kW | 0.3 kW<br>0.2 kW |
| Short-time power rating $P_{max}$ | 25 kW | 25 kW<br>10 kW |
| Cycle time | 10 s | |
| Overload duration | 0.6 s | 0.12 s; 0.2 s |
| Peak rating $E_{max}$ | 7.5 kWs; 180 kWs | 7.5 kWs; 13.5 kWs |

2

## HF commutating reactors, supply voltage 400/480 V 3-phase AC

| | |
|---|---|
| Supply voltage | 400 V 3-phase AC ± 10 % to 480 V 3-phase AC + 6 % – 10 % |
| Frequency | 50/60 Hz ± 10 % |
| Degree of protection | IP 00 in accordance with DIN EN 60 529 (IEC 60 529) |
| Humidity classification according to DIN EN 60 721-3-3 | Cl. 3K5, condensation and icing excluded.<br>Low air temperature: +32 °F (0 °C) |
| Permissible ambient temperature<br>• Operation<br>• Storage and transport | <br>–13 °F to +104 °F (–25 °C to +40 °C), up to +131 °F (+55 °C) with derating<br>–13 °F to +176 °F (–25 °C to +80 °C) |

## Mains filters

| | |
|---|---|
| Supply voltage[1]) | 400 V 3-phase AC ± 10 % or 415 V 3-phase AC ± 10 % (TN network) |
| Frequency | 50/60 Hz ± 10 % |
| Degree of protection | IP 20 according to DIN EN 60 529 (IEC 60 529) |
| Humidity classification according to DIN EN 60 721-3-3 | Cl. 3K5, condensation and icing excluded.<br>Low air temperature: +32 °F (0 °C) |
| Permissible ambient temperature<br>• Operation<br><br>• Storage and transport | <br>+32 °F to +104 °F (0 °C to +40 °C), up to +131 °F (+55 °C)<br>with 0.6 x $P_{rated}$ of the O/I or I/RF module<br>–13 °F to +158 °F (–25 °C to +70 °C) |
| Interference suppression | According to EN 55 011, conducted limit class A<br>if configured according to the Planning Guide |

## Monitoring module

| | |
|---|---|
| Rated supply voltage | 400 V 3-phase AC – 10 % to 480 V 3-phase AC<br>+ 6 % 50 Hz to 60 Hz ± 10 % or 490 V to 680 V DC |
| Power loss | 70 W |

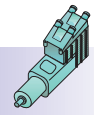
## Overvoltage limiter module

| | |
|---|---|
| Maximum energy absorption | 100 joule |

1) If a mains filter required, direct connection to 480 V 3-phase AC input is not possible. A separate isolation transformer is required. Further, output of the system will be reduced to approx. 350 V A. Take care to select the motor based on this rating.

## Motor Data

| | |
|---|---|
| Supply voltage | 24 V DC ± 20 %<br>Rated power and voltage are reduced when the power supply voltage drops below 24 V. |
| Motor type | Permanent-magnet brushless servomotor (brushless DC: BLDC) |
| Degree of Protection<br>(to DIN EN 60 529) | IP 54 (TENV)<br>IP 40 at the motor shaft and planetary gearbox shaft. The shaft may not run in an oil bath.<br>If necessary, grease lubrication must be provided. |
| Cooling | Non-ventilated (free convection) |
| Overload<br>• S3 15 %, 60 s<br>• Monitoring | <br>2 x rated torque for 15 s within 60 s<br>$I^2t$ limit |
| Position encoder (integrated) | Incremental<br>Resolution 816 ppr |
| Rated motor speed | 3000 rpm |
| Rated motor torque | 1.6 $lb_f$-in (0.18 Nm) |
| Rated motor current | 4.5 A |
| Motor efficiency | 65 % |
| Motor moment of inertia | 0.531 x $10^{-3}$ lb-in-$s^2$ (0.06 x $10^{-3}$ $kgm^2$) |
| Permissible ambient temperature<br>(to DIN EN 60 721,<br>Part 3-3 class 3K5)<br>• Operating<br>• Extended operating<br>• Transport and storage | <br><br><br>+32 °F to 113 °F (0 °C to 45 °C)<br>+32 °F to 149 °F (0 °C to 65 °C) (with continuous current reduction)<br>–40 °F to 158 °F (–40 °C to 70 °C) (to DIN EN 60 721, Parts 3-1 and 3-2, classes 2K4 and 1K4) |
| Installation altitude | 3300 ft (1000 m) above sea level<br>4900 ft (1500 m) Derating factor 0.91<br>6600 ft (2000 m) Derating factor 0.88<br>9900 ft (3000 m) Derating factor 0.83<br>14800 ft (4500 m) Derating factor 0.75<br>19700 ft (6000 m) Derating factor 0.68 |
| Gearbox lifetime | A generally valid statement regarding the gearbox lifetime cannot be made due to the diversity of applications possibilities and the resulting load types as well as the extremely wide range of ambient conditions.<br><br>**Caution!**<br><br>If the worm gear must be rotated due to the mechanical configuration, the retaining bolts must be subsequently tightened with a torque of 1.5 $lb_f$-ft (2 Nm) and secured using Loctite 274. Warranty is not provided for damage if incorrectly handled. |
| Vibration stressing in operation<br>(to IEC 68-2-6, DIN EN 60 721,<br>Parts 3-0 and 3-3, class 3M6) | Frequency range 2 … 9 Hz with constant deflection = 0.276 in (7 mm)<br>Frequency range 9 … 200 Hz with constant acceleration = 65.6 ft/$s^2$ (20 m/$s^2$) |
| Shock stressing in operation<br>(to DIN EN 60 721<br>Parts 3-0 and 3-3, class 3M8)<br>• Peak acceleration<br>• Shock duration | <br><br>max. 250 $ms^2$<br>6 ms |
| Vibration and shock stressing during transport | To DIN EN 60 721, Part 3-3, class 2M2<br>(data is valid for components in their original packing) |
| List of materials | • Electronic housing GD-ALSi12 (CU) (die cast aluminum)<br>• Motor bearing end-shields GD-ZNAL4 (zinc die cast)<br>• Motor shaft 100CR6 DIN 17 350<br>• Gearbox end-shield GD-ZNAL4 (zinc die cast)<br>• Gearbox shaft X40CR13 DIN 17 440<br>• Gearbox flange X12CR MO S17 DIN 17 440<br>• Gearbox hollow wheel (housing) 16MN CR5 BKW; galvanized surface |
| Stressing as a result of cooling and lubrication medium | The stressing of seals was tested using various cooling and lubricating mediums.<br>The result of the tests of compatible mediums can be requested when required.<br>However, incompatibilities cannot be generally excluded due to the continually changing chemical composition for cooling and lubricating mediums. |



2

### Overload characteristic

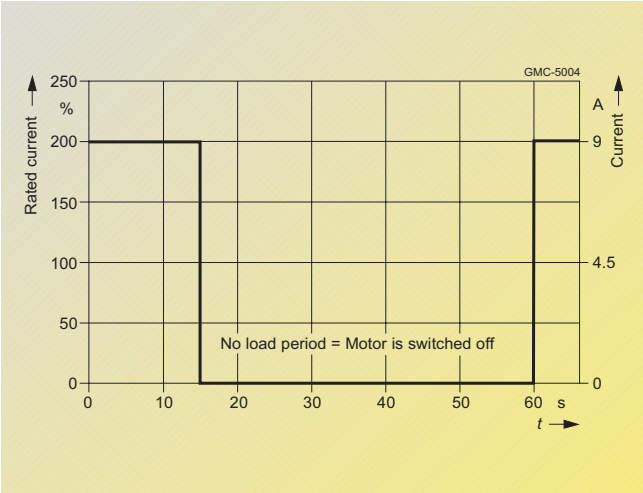



Fig. 2/12
Overload capabilities POSMO A S3 15 %, 1 min

### Derating factors

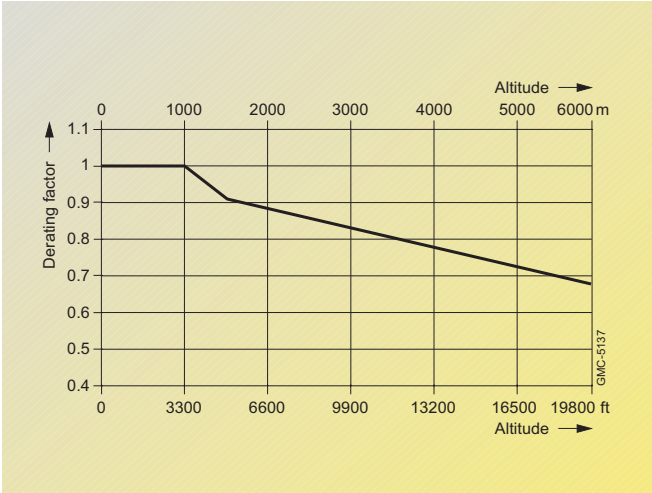



Fig. 2/13
Derating factor as a function of altitude

### Reduction curves

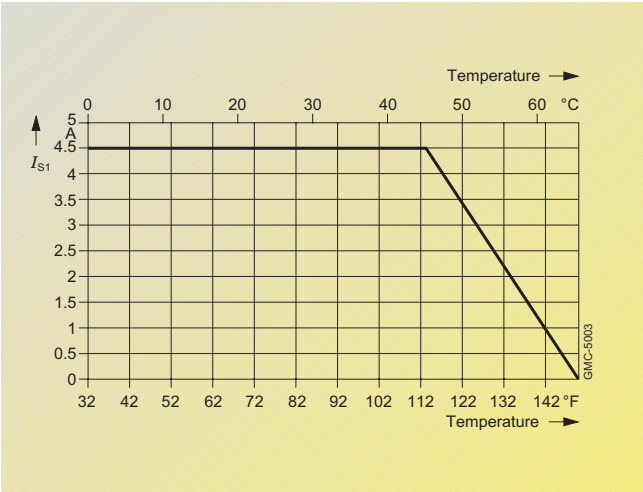
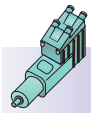



Fig. 2/14
Current reduction as a function of ambient temperature





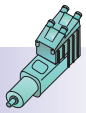
## SITOP 24 V Power supply standard type

| | AC single-phase units | AC three-phase units |
|---|---|---|
| Rated input voltage | 1 ~ 120/230 V AC ± 15 % | 3 ~ 400 to 500 V ± 10 % |
| Rated line frequency | 50/60 Hz; 47 to 63 Hz | |
| Overload monitoring | $I^2t$ limit monitoring | |
| Integral input fuse | Yes | None |
| Supply cable protection | Recommended | Required |
| Output | Regulated floating direct voltage | |
| Rated output voltage | 24 V DC ± 3 % | |
| Parallel connection to increase power | Yes (only for ambient temperatures from 32 °F to 113 °F / 0 °C to 45 °C) | |
| Output overvoltage protection | Yes to EN 60 950 | |
| Short circuit protection | Electronic shutdown, automatic restart | |
| Approvals | UL/cuL (CSA), CE | |
| Degree of protection | IP 20 | |
| Isolation primary/secondary | Yes, SELV output voltage $V_{out}$ to EN 60 950 | |
| Protection class (IEC 536) | Class 1 | |
| Line harmonics limiting | EN 61 000-3-2 | |
| Spurious emission | EN 50 081-1, EN 55 022 Class B | |
| Operating ambient temperature | +32 °F to +131 °F (0 °C to +55 °C) with natural convection | |
| Transportation and storage temperature | –4 °F to +185 °F (–20 °C to +85 °C) | |
| Humidity class | Climatic class 3K3 to EN 60 721 | |

## Power management module (PMM)

| | |
|---|---|
| Rated input voltage | 24 V DC |
| Operating voltage range | 19.2 V DC to 28.8 V DC |
| Max. permissible continuous current via PMM | 28 A at +104 °F (+40 °C) ambient temperature |
| Overload monitoring | $I^2t$ limit monitoring to protect pulse resistor |
| Type of relay | Monostable relay with alternating contact |
| Maximum relay switching voltage | 150 V DC/125 V AC |
| Operating temperature | +32 °F to +131 °F (0 °C to +55 °C) |
| Storage and transport temperature | –13 °F to +185 °F (–25 °C to +85 °C) |
| Type of protection | IP 20 as per IEC 529 |

## Power cable




### 6FX50 08-5FA00 power cable

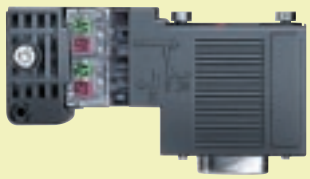
| | |
|---|---|
| Certifications | UL style No. 2570 |
| Electrical resistance | IEC 228 / CEI 20-29 CL.5 |
| Test voltage | 2000 V AC |
| Rated voltage | 600 V AC |
| Insulation resistance per kilometer (0.625 miles) at +68 °F (+20 °C) | ≥ 100 MΩ |
| Storage temperature | +14 °F to +176 °F (–10 °C to +80 °C) |
| Operating temperature | +32 °F to +176 °F (0 °C to +80 °C) |
| Bending radius | 15 x D |
| Outer sheath | PVD |



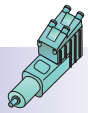
### 6ES71 94-1LY00-0AA0 and 6ES71 94-1LY10-0AA0 power cable

| | 6ES71 94-1LY00-0AA0 | 6ES71 94-1LY10-0AA0 |
|---|---|---|
| Other sheath | PVC | PUR |
| Outer sheath thickness | 0.0315 in (0.8 mm) | |
| Leads cross sections | 1 x 2 x 0.65 $mm^2$ + 3 x 1 x 0.75 $mm^2$ | |
| Outside diameter | 0.374 in ± 0.02 in (9.5 ± 0.5 mm) | |
| Permissible minimum bending diameter<br>• Once-only bending<br>• Recurrent bending | <br>≥ 2.76 in (70 mm)<br>≥ 5.51 in (140 mm) | |
| Operating temperature | –22 °F to +140 °F (–30 °C to +60 °C) | |
| Weight | Approx. 144.7 lb/mile (105 kg/km) | |
| Electrical properties at 68 °F (20 °C)<br>• Conductor resistance<br><br>• Insulation resistance<br>• Operating voltage (peak)<br>• Test voltage | <br>≤ 26 Ω/km for 0.75 $mm^2$<br>≤ 84 Ω/km for 0.65 $mm^2$<br>≥ 20 MΩ/km<br>35 V<br>500 V | |
| Flame test | To VDE 0472, Part 804, test type B | |
| Oil resistance | – | To VDE 0471, Part 804, test type B |
| Suitable for drum use | – | Yes |

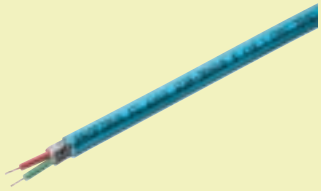
## Bus connectors, technical specifications

| | 6ES79 72-0BA50-0XA0<br>6ES79 72-0BB50-0XA0 | 6GK15 00-0FC00 |
|---|---|---|
| |  | |
| Cable outlet | **90°** cable outlet | **180°** cable outlet |
| Transmission rate | 9.6 Kbit/s … 12 Mbit/s | 9.6 Kbit/s … 12 Mbit/s |
| Terminating resistor | Integrated resistor<br>combination to be enabled via slide switch<br>Isolation function:<br>With the resistor connected, the outgoing bus is isolated.<br>Connected with insulation displacement techique for FastConnect system | Integrated resistor<br>combination to be enabled via slide switch<br>Isolation function:<br>With the resistor connected, the outgoing bus is isolated.<br>Connected with insulation displacement techique for FastConnect system |
| Interfaces<br>• PROFIBUS stations<br>• PROFIBUS LAN cable | 9-pin sub-D female connector<br>4 insulation displacement terminals for all FastConnect PROFIBUS cables (except FC Process Cable) | 9-pin sub-D female connector<br>4 insulation displacement terminals for all FastConnect PROFIBUS cables (except FC Process Cable) |
| Supply voltage (to be supplied by DTE) | 4.75 to 5.25 V DC | 4.75 to 5.25 V DC |
| Current consumption | Max. 5 mA | Max. 5 mA |
| Permissible ambient conditions<br>• Operating temperature<br>• Transportation/storage temperature<br>• Relative humidity | –13 °F to 176 °F (0 °C to +60 °C)<br>+32 °F to 140 °F (–25 °C to +80 °C)<br>Max. 75 % at 77 °F (+25 °C) | –13 °F to 176 °F (0 °C to +60 °C)<br>+32 °F to 140 °F (–25 °C to +80 °C)<br>Max. 75 % at 77 °F (+25 °C) |
| Construction<br>• Dimensions (W x H x D) in in (mm)<br>• Weight | 2.86 x 0.63 x 1.34 (72.7 x 16 x 34)<br>approx. 0.11 lb (50 g) | 0.59 x 2.24 x 1.54 (15 x 57 x 39)<br>approx. 0.22 lb (100 g) |
| PG female connector | **0BA50: no; 0BB50: yes** | **no** |
| Degree of protection | IP 20 | IP 20 |

## LAN cables for PROFIBUS




### LAN cables[1]), technical specifications

| | PROFIBUS FC standard cable | PROFIBUS FC robust cable | PROFIBUS 2)3) FC trailing cable |
|---|---|---|---|
| | | |  |
| Attenuation<br>• at 16 MHz<br>• at 4 MHz<br>• at 9.6 kHz | < 42 dB/km<br>< 22 dB/km<br>< 2.5 dB/km | < 42 dB/km<br>< 22 dB/km<br>< 2.5 dB/km | < 49 dB/km<br>< 25 dB/km<br>< 3 dB/km |
| Impedance<br>• at 9.6 kHz<br>• at 38.4 kHz<br>• at 3 to 20 MHz | 270 ± 27 Ω<br>185 ± 18.5 Ω<br>150 ± 15 Ω | 270 ± 27 Ω<br>185 ± 18.5 Ω<br>150 ± 15 Ω | 270 ± 27 Ω<br>185 ± 18.5 Ω<br>150 ± 15 Ω |
| Rated value | 150 Ω | 150 Ω | 150 Ω |
| Loop resistance | ≤ 110 Ω/km | ≤ 110 Ω/km | ≤ 133 Ω/km |
| Shield resistance | ≤ 9.5 Ω/km | ≤ 9.5 Ω/km | ≤ 14 Ω/km |
| Effective capacitance at 1 kHz | approx. 28.5 nF/km | approx. 28.5 nF/km | approx. 28.5 nF/km |
| Operating voltage (rms value) | ≤ 100 V | ≤ 100 V | ≤ 100 V |
| Type of cable (standard code) | 02YY (ST) CY<br>1 x 2 x 0.64/2.55-<br>150 KF 40 FR VI | 02YSY (ST) C11Y<br>1 x 2 x 0.64/2.55-<br>150 KF 40 FRNC VI | 02Y Y (ST) C11Y<br>1 x 2 x 0.64/2.55-<br>150 LI KF 40 FR petrol |
| Sheath<br>• Material<br>• Diameter<br>• Color | PVC<br>0.3/5 in ± 0.016 (8.0 ± 0.4 mm)<br>purple | PUR<br>0.3/5 in ± 0.016 (8.0 ± 0.4 mm)<br>purple | PUR<br>0.3/5 in ± 0.016 (8.0 ± 0.4 mm)<br>purple |
| Permissible ambient conditions<br>• Operating temperature<br>• Transportation/storage temperature<br>• Installation temperature | –40 °F to +140 °F (–40 °C to +60 °C)<br>–40 °F to +140 °F (–40 °C to +60 °C)<br>–40 °F to +140 °F (–40 °C to +60 °C) | –40 °F to +140 °F (–40 °C to +60 °C)<br>–40 °F to +140 °F (–40 °C to +60 °C)<br>–40 °F to +140 °F (–40 °C to +60 °C) | –40 °F to +140 °F (–40 °C to +60 °C)<br>–40 °F to +140 °F (–40 °C to +60 °C)<br>–40 °F to +140 °F (–40 °C to +60 °C) |
| Bending radii<br>• First & final bending<br>• Repeated bending | ≥ 2.95 in (≥ 75 mm)<br>≥ 5.91 in (≥ 150 mm) | ≥ 2.95 in (≥ 75 mm)<br>≥ 5.91 in (≥ 150 mm) | ≥ 1.575 in (≥ 40 mm)<br>≥ 2.362 in (≥ 60 mm) |
| Permissible tensile load | 22.5 $lb_f$ (100 N) | 22.5 $lb_f$ (100 N) | 22.5 $lb_f$ (100 N) |
| Weight | 104.7 lb/mile (76 kg/km) | 100.6 lb/mile (73 kg/km) | 102 lb/mile (74 kg/km) |
| Free of halogen | no | no | no |
| Behavior in fire | flame-retardant<br>acc. to VDE 0472<br>T804<br>C test type | flame-retardant<br>acc. to VDE 0472<br>T804<br>B test type | flame-retardant<br>acc. to VDE 0472<br>T804<br>B test type |
| UL listing | yes | yes | yes |
| Resistance to mineral oils and greases | conditionally resistant | good resistance | good resistance |
| UV resistance | no | no | yes |

1) Electrical characteristics at 20 °C, tested according to DIN 47 250 Part 4 or DIN VDE 0472.

2) Trailing-type cables for the following requirements: min. of 4 million bending cycles at the specified bending radius and a max. acceleration of 4 $m/s^2$.

3) Restricted segment lengths (see the manual for PROFIBUS networks).

# SIMODRIVE 611 universal POSMO A

# Selection and Ordering Data


*SIMODRIVE 611 universal*

**System components**

3/2 Infeed modules
3/2 Power modules
3/3 Plug-in units
3/4 Overvoltage limiter
3/5 Monitoring module
3/5 Pulsed resistor module
3/5 External pulsed resistor
3/5

**Software**

3/6 2-tier configuration
3/6 Additional components
3/6 Software

**Mechanical components**

3/7 External cooling
3/8 Hose (pipe) cooling
3/8 Fan for internal and external cooling
3/8 Shield terminal plate
3/9

**System components/Line side components**

3/10 HF commutating reactors
3/10 Mains filters
3/10 Mains filters package
3/11 Demo unit
3/11 Start-up box
3/11 Training courses

*SIMODRIVE POSMO A*

**Intelligent positioning motor**

3/13 POSMO A 0.1 HP (75 W)

**Cables and connectors**

3/14 Power cable
3/14 PROFIBUS cables and connectors

**Requirements**

3/15 Power Management Module
3/15 Demonstration units
3/16 SITOP Power

## Infeed modules

| Unregulated control with pulsed resistor | Regulated control with regenerative feedback | Infeed[14] power S6 –40% | Peak infeed power | Rated supply current | Peak supply current | **Infeed module** | Power loss | Module width | For dimension drawing, see Section 7 | Weight | Feedback power |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Rated DC link power (S1) | Rated DC link power (S1) | | | | | | with fan/ without fan | | | | continuous/ peak |
| HP (kW) | HP (kW) | HP (kW) | HP (kW) | A | A | Order No. | W | in (mm) | Fig. No. | lb (kg) | kW |
| **Internal cooling** | | | | | | | | | | | |
| **6.5**[4] **(5)** | – | 8.8 (6.5) | 13.6 (10) | 12.5 | 25 | **6SN11 46-1AB00-0BA1** | –/270[5])[6] | 1.97 (50) | 7/14 | 14.3 (6.5) | 0.2/10[4])[11] |
| **13.5**[4] **(10)** | – | 17.5 (13) | 34 (25) | 24 | 60 | **6SN11 45-1AA01-0AA1** | –/450[6] | 3.9 (100) | 7/14 | 20.9 (9.5) | 0.3/25[4])[11] |
| **38 (28)** | – | 49 (36) | 68 (50) | 65 | 116 | **6SN11 45-1AA00-0CA0** | –/250 | 7.9 (200) | 7/14 | 34.1 (15.5) | –[10] |
| – | **22 (16)** | 28.5 (21) | 47.6 (35) | 27 | 59 | **6SN11 45-1BA01-0BA1** | –/320 | 3.9 (100) | 7/14 | 23.1 (10.5) | 16/35[12] |
| – | **49 (36)** | 64 (47) | 95.2 (70) | 60.5 | 117.5 | **6SN11 45-1BA02-0CA1** | –/585 | 7.9 (200) | 7/14 | 34.1 (15.5) | 36/70[12] |
| – | **75 (55)** | 96.5 (71) | 124 (91) | 92.5 | 153 | **6SN11 45-1BA01-0DA1** | –/745 | 11.8 (300) | 7/14 | 57.2 (26) | 55/91[12] |
| – | **109 (80)** | 141 (104) | 178 (131) | 134 | 220 | **6SN11 45-1BB00-0EA1** | –/1280[7]) | 11.8 (300) | 7/15 | 57.2 (26) | 80/131[12] |
| – | **160 (120)** | 212 (156) | 238 (175) | 202 | 294 | **6SN11 45-1BB00-0FA1** | –/1950[7]) | 11.8 (300) | 7/15 | 57.2 (26) | 120/175[12] |
| **External cooling** | | | | | | | | | | | |
| **6.5**[4] **(5)** | – | 8.8 (6.5) | 13.6 (10) | 12.5 | 25 | **6SN11 46-1AB00-0BA1**[13]) | 270/–[5]) | 1.97 (50) | 7/18 | 14.3 (6.5)[8]) | 0.2/10[4])[11] |
| **13.5**[4] **(10)** | – | 17.5 (13) | 34 (25) | 24 | 60 | **6SN11 45-1AA01-0AA1**[13]) | 119/331 | 3.9 (100) | 7/18 | 20.9 (9.5)[8]) | 0.3/25[4])[11] |
| **38 (28)** | – | 49 (36) | 68 (50) | 65 | 116 | **6SN11 46-1AB00-0CA0**[13]) | 90/160 | 7.9 (200) | 7/18 | 34.1 (15.5)[8]) | –[10] |
| – | **22 (16)** | 28.5 (21) | 47.6 (35) | 27 | 59 | **6SN11 46-1BB01-0BA1**[13]) | 50/270 | 3.9 (100) | 7/18 | 23.1 (10.5)[8]) | 16/35[12] |
| – | **49 (36)** | 64 (47) | 95.2 (70) | 60.5 | 117.5 | **6SN11 46-1BB02-0CA1**[13]) | 50/535 | 7.9 (200) | 7/24 | 34.1 (15.5)[8]) | 36/70[12] |
| – | **75 (55)** | 96.5 (71) | 124 (91) | 92.5 | 153 | **6SN11 46-1BB00-0DA1**[13]) | 115/630 | 11.8 (300)[2]) | 7/25 | 57.2 (26)[8]) | 55/91[12] |
| – | **109 (80)** | 141 (104) | 178 (131) | 134 | 220 | **6SN11 46-1BB00-0EA1**[13]) | 190/1090 | 11.8 (300)[3]) | 7/25 | 57.2 (26)[8]) | 80/131[12] |
| – | **160 (120)** | 212 (156) | 238 (175) | 202 | 294 | **6SN11 46-1BB00-0FA1**[13]) | 290/1660 | 11.8 (300)[3]) | 7/25 | 63.8 (29)[8]) | 120/175[12] |
| **Hose (pipe) cooling** | | | | | | | | | | | |
| – | **75 (55)** | 96.5 (71) | 124 (91) | 92.5 | 153 | **6SN11 45-1BB00-0DA1**[2]) | 115/630 | 11.8 (300)[3]) | 7/16 | 57.2 (26)[9]) | 55/91[12] |
| – | **109 (80)** | 141 (104) | 178 (131) | 134 | 220 | **6SN11 45-1BB00-0EA1**[2]) | 190/1090 | 11.8 (300)[3]) | 7/16 | 57.2 (26)[9]) | 80/131[12] |
| – | **160 (120)** | 212 (156) | 238 (175) | 202 | 294 | **6SN11 45-1BB00-0FA1**[2]) | 290/1660 | 11.8 (300)[3]) | 7/16 | 63.8 (29)[9]) | 120/175[12] |

1) For external cooling, the fan box is part of the scope of supply of the mounting frame for the 11.8 in (300 mm) module width. The required 6SN11 62-0BA02-0AA1 built-on fan must be ordered separately.

2) The mounting frame can be omitted if the required openings for the module heat sinks are made as specified in the Planning Guide in the cabinet rear panel. The above-mentioned mounting frame 6SN11 62-0BA04-0EA0 must be used with modules that are 11.8 in (300 mm) wide.

3) A built-on fan 6SN11 62-0BA02-0AA1 is required for these 11.8 in (300 mm) modules for the internal cooling.

4) Housing suitable for drive groups with internal and external cooling.

5) 109 HP/160 HP (80 kW/120 kW) I/RF (aka. I/R) modules require an external control voltage for the internal line contactor.
360 to 457 V AC 2-phase/45 Hz to 53 Hz;
400 V to 510 V AC 2-phase/57 Hz to 65 Hz.

6) Including the part of the internal pulsed resistor.

7) Built-on fan 6SN11 62-0BA02-0AA1 is needed.

8) Without built-in components.

9) Without hose cooling kit.

10) Max. connectable external pulsed resistor 2 x 2 HP/34 HP (1.5 kW/25 kW).

11) Performance of integrated pulsed resistor.

12) Regenerative feedback power.

13) Mounting frame for switching cabinet is needed, see mechanical components.

14) Load duty cycle with pre-loading conditions see section 6.

## Power modules

| Power modules for 1FT6/1FK6/1FN3 motors | | | Power modules for 1PH motors[4] | | | Power module | Module width | For dimension drawing, see Section 7 | Weight |
|---|---|---|---|---|---|---|---|---|---|
| Rated current | Peak current | Power[8] loss total/ internal/ external | Rated current | Peak current | Power[8] loss total/ internal/ external | | | | |
| A | A | W | A | A | W | Order No. | in (mm) | Fig. No. | lb (kg) |
| **Internal cooling[1]** | | | | | | | | | |
| **1-axis Version** | | | | | | | | | |
| **3** | **6** | 35/–/– | **3** | **3** | 30/–/– | **6SN11 23-1AA00-0HA1** | 1.97 (50) | 7/14 | 14.3 (6.5) |
| **5** | **10** | 50/–/– | **5** | **8** | 40/–/– | **6SN11 23-1AA00-0AA1** | 1.97 (50) | 7/14 | 14.3 (6.5) |
| **9** | **18** | 90/–/– | **8** | **16** | 74/–/– | **6SN11 23-1AA00-0BA1** | 1.97 (50) | 7/14 | 14.3 (6.5) |
| **18** | **36** | 190/–/– | **24** | **32** | 260/–/– | **6SN11 23-1AA00-0CA1** | 1.97 (50) | 7/14 | 16.5 (7.5) |
| **28** | **56** | 300/–/– | **30** | **51** | 320/–/– | **6SN11 23-1AA00-0DA1** | 3.9 (100) | 7/14 | 20.9 (9.5) |
| **–** | **–** | – | **45** | **76** | 460/–/– | **6SN11 23-1AA00-0LA1** | 5.9 (150) | 7/14 | 28.6 (13) |
| **56** | **112** | 645/–/– | **60** | **102** | 685/–/– | **6SN11 23-1AA00-0EA1** | 5.9 (150) | 7/14 | 28.6 (13) |
| **70** | **140** | 730/–/– | **85** | **127** | 850/–/– | **6SN11 23-1AA01-0FA1** | 11.8 (300) | 7/14 | 57.2 (26)[6] |
| **–** | **–** | – | **120** | **193** | 1290/–/– | **6SN11 23-1AA00-0JA1** | 11.8 (300) | 7/15 | 46.2 (21)[6] |
| **140** | **210** | 1910/–/– | **200** | **257** | 2170/–/– | **6SN11 23-1AA00-0KA1** | 11.8 (300) | 7/15 | 52.8 (24)[6] |
| **2-axis Version** | | | | | | | | | |
| **2 x 3** | **2 x 6** | 70/–/– | **2 x 3** | **2 x 8** | | **6SN11 23-1AB00-0HA1** | 1.97 (50) | 7/20 | 15.4 (7) |
| **2 x 5** | **2 x 10** | 100/–/– | **2 x 5** | **2 x 8** | | **6SN11 23-1AB00-0AA1** | 1.97 (50) | 7/20 | 15.4 (7) |
| **2 x 9** | **2 x 18** | 180/–/– | **2 x 8** | **2 x 16** | | **6SN11 23-1AB00-0BA1** | 1.97 (50) | 7/20 | 15.4 (7) |
| **2 x 18** | **2 x 36** | 380/–/– | | on request | | **6SN11 23-1AB00-0CA1** | 3.9 (100) | 7/22 | 29.7 (13.5) |
| **External cooling[2][7]** | | | | | | | | | |
| **1-axis Version** | | | | | | | | | |
| **3** | **6** | –/14/21 | **3** | **3** | –/12/18 | **6SN11 24-1AA00-0HA1** | 1.97 (50) | 7/19 | 14.3 (6.5) |
| **5** | **10** | –/19/31 | **5** | **8** | –/16/24 | **6SN11 24-1AA00-0AA1** | 1.97 (50) | 7/19 | 14.3 (6.5) |
| **9** | **18** | –/35/55 | **8** | **16** | –/29/45 | **6SN11 24-1AA00-0BA1** | 1.97 (50) | 7/19 | 14.3 (6.5) |
| **18** | **36** | –/65/125 | **24** | **32** | –/89/171 | **6SN11 24-1AA00-0CA1** | 1.97 (50) | 7/19 | 16.5 (7.5) |
| **28** | **56** | –/30/270 | **30** | **51** | –/32/288 | **6SN11 24-1AA00-0DA1** | 3.9 (100) | 7/21 | 20.9 (9.5) |
| **–** | **–** | – | **45** | **76** | –/19/441 | **6SN11 24-1AA00-0LA1** | 5.9 (150) | 7/23 | 28.6 (13) |
| **56** | **112** | –/25/620 | **60** | **102** | –/30/655 | **6SN11 24-1AA00-0EA1** | 5.9 (150) | 7/23 | 28.6 (13) |
| **70** | **140** | –/90/640 | **85** | **127** | –/100/750 | **6SN11 24-1AA01-0FA1** | 11.8 (300) | 7/25 | 57.2 (26)[6] |
| **–** | **–** | – | **120** | **193** | –/190/1100 | **6SN11 24-1AA00-0JA1** | 11.8 (300) | 7/25 | 46.2 (21)[6] |
| **140** | **210** | –/250/1660 | **200** | **257** | –/325/1845 | **6SN11 24-1AA00-0KA1** | 11.8 (300) | 7/25 | 52.8 (24) |
| **2-axis Version** | | | | | | | | | |
| **2 x 3** | **2 x 6** | –/27/43 | **2 x 3** | **2 x 8** | | **6SN11 24-1AB00-0HA1** | 1.97 (50) | 7/20 | 15.4 (7) |
| **2 x 5** | **2 x 10** | –/38/62 | **2 x 5** | **2 x 8** | | **6SN11 24-1AB00-0AA1** | 1.97 (50) | 7/20 | 15.4 (7) |
| **2 x 9** | **2 x 18** | –/69/111 | **2 x 8** | **2 x 16** | | **6SN11 24-1AB00-0BA1** | 1.97 (50) | 7/20 | 15.4 (7) |
| **2 x 18** | **2 x 36** | –/130/250 | | on request | | **6SN11 24-1AB00-0CA1** | 3.9 (100) | 7/22 | 29.7 (13.5) |
| **Hose (pipe) cooling[3]** | | | | | | | | | |
| **1-axis Version** | | | | | | | | | |
| **70** | **140** | 730/–/– | **85** | **127** | 460/–/– | **6SN11 23-1AA02-0FA1**[5] | 11.8 (300) | 7/16, 7/17 | 28.6 (13)[6] |
| **–** | **–** | – | **120** | **193** | 1230/–/– | **6SN11 23-1AA00-0JA1** | 11.8 (300) | 7/16, 7/17 | 46.2 (21)[6] |
| **140** | **210** | 1910/–/– | **200** | **254** | 2710/–/– | **6SN11 23-1AA00-0KA1** | 11.8 (300) | 7/16, 7/17 | 52.8 (24) |

1) **Internal cooling**
A **built-on fan** is required for the power modules 6SN11 23-1AA00-0JA1 and ...-0KA1;
Order No.: **6SN11 62-0BA02-0AA1**.

2) **External cooling**
The fan box is part of the scope of supply of the mounting frame for the 11.820 in (300 mm) module width for external cooling. The corresponding **built-on fan** must be ordered separately;
Order No.: **6SN11 62-0BA02-0AA1**.

3) **Hose cooling**
A hose cooling assembly kit with fan, hose, flanges and filter mat is required for each module.
Order No. for the **hose cooling assembly kit: 6SN11 62-0BA03-0AA1**.

4) Also for standard ILA induction motors only.

5) For hose cooling in 2-tier installations (permissible only for 75 HP (35 kW) I/RF (aka. I/R) modules and 85 A induction motors):
**Hose connection kit 2-tier installation;**
Order No.: **6SN11 61-0BA03-0CA1**.

6) Without mounting and hose cooling components.

7) Mounting frame for switching cabinet is needed, see mechanical components.

8) Total: power loss from the module as a whole.
Internal: residual power loss in the switching cabinet.
External: Power loss dissipated directly to atmosphere.
The details apply to the corresponding rated pulse frequency of the inverters.

## Plug-in units

| Designation | | Order No. | Weight, approx. lb (kg) | Dimensions W x H x D in x in x in (mm x mm x mm) |
|---|---|---|---|---|
| **Closed loop control plug-in unit with analog speed setpoint interface** | | | | |
| **1-axis version** | Resolver, speed/torque setpoint | **6SN11 18-0NJ00-0AA1** | 2 (0.91) | 1.772 x 12.265 x 4.724 (4.5 x 31 x 12) |
| | Resolver, speed/torque setpoint, positioning | **6SN11 18-1NJ00-0AA1** | 2 (0.91) | 1.772 x 12.265 x 4.724 (4.5 x 31 x 12) |
| **2-axis version** | Resolver, speed/torque setpoint | **6SN11 18-0NK00-0AA1** | 2 (0.91) | 1.772 x 12.265 x 4.724 (4.5 x 31 x 12) |
| | Resolver, speed/torque setpoint, positioning | **6SN11 18-1NK00-0AA1** | 2 (0.91) | 1.772 x 12.265 x 4.724 (4.5 x 31 x 12) |
| | sin/cos 1 $V_{pp}$/absolute encoder, speed/torque setpoint | **6SN11 18-0NH00-0AA1** | 2 (0.91) | 1.772 x 12.265 x 4.724 (4.5 x 31 x 12) |
| | sin/cos 1 $V_{pp}$/absolute encoder, speed/torque setpoint, positioning | **6SN11 18-1NH00-0AA1** | 2 (0.91) | 1.772 x 12.265 x 4.724 (4.5 x 31 x 12) |
| **Option modules for the plug-in unit** | | | | |
| **Terminal module for axis A** | 8 digital inputs/8 digital outputs, 24 V/500 mA (max.), electrically isolated, parameterizable | **6SN11 14-0NA00-0AA0** | 0.25 (0.11) | 0.984 x 2.362 x 4.724 (2.5 x 6 x 12) |
| **PROFIBUS-DP** | Standard slave for up to two axes for cyclical and acyclical (V1) data exchange up to 12 Mbaud | **6SN11 14-0NB00-0AA1** | 0.25 (0.11) | 0.984 x 2.362 x 4.724 (2.5 x 6 x 12) |
| **Motion control with PROFIBUS-DP3** | Synchronous standard slave for up to two axes for cyclical and acyclical (V1) data exchange up to 12 Mbaud | **6SN11 14-0NB01-0AA0** | 0.25 (0.11) | 0.984 x 2.362 x 4.724 (2.5 x 6 x 12) |

**Note:**
Shield terminal plates are required to fit shields to the encoder cables (see mechanical components).

## Overvoltage limiter

| Designation | | Order No. | Weight approx. lb (kg) | Dimensions W x H x D in x in x in (mm x mm x mm) |
|---|---|---|---|---|
| **Overvoltage limiter module** | For mains infeed modules above 13.6 HP (10 kW) for SIMODRIVE 611 | **6SN11 11-0AB00-0AA0** | 0.66 (0.3) | 2.758 x 2.994 x 12.80 (70 x 76 x 325) |

**Note:**
- With the overvoltage module the infeed module has a max. module depth of 12.805 in (325 mm).
- For UL compliance a overvoltage limiter module must be used.
- In the 6.8 HP (5 kW) O/I (aka. U/E) module an appropriate protective circuit is integrated.

## Monitoring module

| Designation | | Order No. | Power loss | Rated supply voltage | Weight approx. lb (kg) | Module width in (mm) |
|---|---|---|---|---|---|---|
| **Monitoring module** | Complete with all termination and connection elements suitable for internal and external cooling | **6SN11 12-1AC01-0AA1** | 70 W | 400 V AC 3-phase –10% to 480 V AC 3-phase +6% 50 Hz to 60 Hz ±10% or 490 V to 680 V DC | 11 (5) | 1.97 (50) |

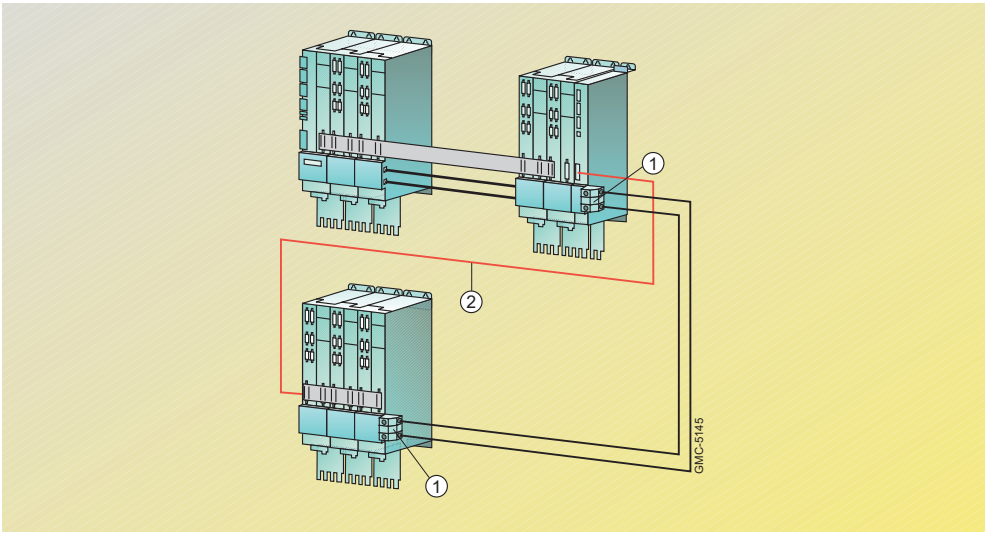
## Pulsed resistor module

| Designation | | Order No. | Power loss | Rated supply voltage | Continuous rating/ peak rating | Weight approx. lb (kg) | Module width in (mm) |
|---|---|---|---|---|---|---|---|
| **Pulsed resistor module** | Complete with all termination and connection elements | **6SN11 13-1AB01-0BA1** | Load-dependent 15 W to max. 315 W | 600 V/625 V/ 680 V DC | • With internal pulsed resistor 0.3 /25 kW<br>• With external pulsed resistor 1.5/25 kW | 11 (5) | 1.97 (50) |

## External pulsed resistor

| Designation | Braking power | Order No. | Degree of protection | Weight approx. lb (kg) | Dimensions W x H x D in x in x in (mm x mm x mm) |
|---|---|---|---|---|---|
| **External pulsed resistor** | 1.5 kW/25 kW | **6SN11 13-1AA00-0CA0** | IP 20 | 12.375 (5.6) | 7.604 x 6.154 x 9.456 (193 x 410 x 240) |
| | 0.3 kW/25 kW only for 28 kW O/I module | **6SN11 13-1AA00-0DA0** | IP 20 | 7.5 (3.4) | 3.29 x 11.032 x 2.147 (83.5 x 280 x 54.5) |

## 2-tier configuration




① Adapter terminal
② Unit bus cable

Fig. 3/1
2-tier configuration

| | Designation | | Order No. |
|---|---|---|---|
| | **Adapter terminals for DC link connection** (for 2-tier configuration) | • Package with two double-terminals 50 mm² for modules 1.970 in (50 mm) to 7.880 in (200 mm) wide | **6SN11 61-1AA01-0BA0** |
| | | • Package with two double-terminals 95 mm² for module 11.820 in (300 mm) wide | **6SN11 61-1AA01-0AA0** |
| | **Unit bus cable** (for 2-tier configuration) | Length: 4 ft 11 in (1.5 m) | **6SN11 61-1AA00-0AA1** |

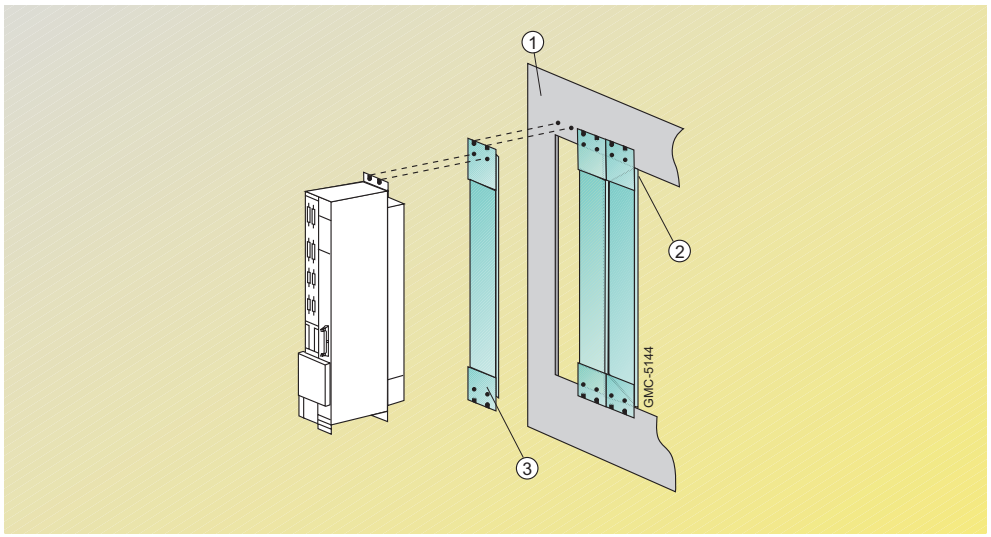
## Additional components

| | Designation | | Order No. | Grid in (mm) |
|---|---|---|---|---|
| | **Shielded contacting clip** for electronics cables | Quantity: 10 | **6SN11 62-0FA00-0AA0** | – |
| | **Note:** The shielded contacting clips for the electronics cables can be installed at the threaded bushes on the power and infeed modules above the closed-loop control plug-in units | | | |
| | **Female coding elements** for plug side (socket) | Quantity: 100 | **6FC9 348-7BA** | 0.197 (5) |
| | **Male coding elements** for pin side | Quantity: 100 | **6FC9 348-7BB** | 0.197 (5) |
| | **Note:** The plug-in terminals on the front panel of the modules can be coded by freely pluggable male coding elements on the pin side and corresponding female coding elements on the plug side (socket).<br>The male and female coding elements are necessary only if the connectors are to be individually coded. The function of the plug-in terminals is not restricted if coding elements are not used. | | | |

## Software

| | Designation | | Order No. |
|---|---|---|---|
| | **SimoCom-U/611 universal toolbox** | Parameterization, start-up and test tool in English, German, French, Italian and Spanish on CD-ROM | **DRMS 02055** |
| | **Drive ES Basic** | Planning program embedded in STEP 7 | **6SW17 00-0JA00-0AA0** |
| | **Drive ES SIMATIC** | Programming block for STEP 7 | **6SW17 00-0JC00-0AA0** |

## External cooling




① Switching cabinet (untreated metal surface)
② Mounting frames sealed against each other an against the back of the switching cabinet (e.g. with Terostat-9 from Teroson company). The sealing agent should be applied continuously such that the degree of protection IP 51 is satisfied.
③ Mounting frame

Fig. 3/2
Mounting frame

| Designation | Size infeed module | Size power module 1FT6/1FK6/1FN3 motors | Size power module 1PH motors | Infeed/power module | **Mounting frame/ blanking plate** Order No. | Width in (mm) |
|---|---|---|---|---|---|---|
| **Mounting frame for switching cabinet installation of an infeed module** for external cooling | 6.5 HP (5 kW) O/I | – | – | 6SN11 46-1AB00-0BA1 | **6SN11 62-0BA04-0JA0** | – |
| | 13.5 HP (10 kW) O/I | – | – | 6SN11 45-1AA01-0AA1 | **6SN11 62-0BA04-0HA1** | – |
| | 38 HP (28 kW) O/I | – | – | 6SN11 46-1AB00-0CA0 | **6SN11 62-0BA04-0DA1** | – |
| | 22 HP (16 kW) I/R | – | – | 6SN11 46-1BB01-0BA1 | **6SN11 62-0BA04-0BA1** | – |
| | 49 HP (36 kW) I/R | – | – | 6SN11 46-1BB02-0CA1 | **6SN11 62-0BA04-0DA1** | – |
| | 75 HP (55 kW) I/R | – | – | 6SN11 46-1BB00-0DA1 | **6SN11 62-0BA04-0EA0** | – |
| | 109 HP (80 kW) I/R | – | – | 6SN11 46-1BB00-0EA1 | **6SN11 62-0BA04-0EA0** | – |
| | 160 HP (120 kW) I/R | – | – | 6SN11 46-1BB00-0FA1 | **6SN11 62-0BA04-0EA0** | – |
| | **Note:** The mounting frame can be omitted if the required openings for the module heat sinks are made as specified in chapter 6 in the cabinet rear panel. The above-mentioned mounting frame 6SN11 62-0BA04-0EA0 must be used with modules that are 11.8 in (300 mm) wide. | | | | | |
| **Mounting frame for switching cabinet installation of a power module** for external cooling | – | 3/ 6 A | 3/ 3 A | 6SN11 24-1AA00-0HA1 | **6SN11 62-0BA04-0AA1** | – |
| | – | 5/ 10 A | 5/ 8 A | 6SN11 24-1AA00-0AA1 | **6SN11 62-0BA04-0AA1** | – |
| | – | 9/ 18 A | 8/ 16 A | 6SN11 24-1AA00-0BA1 | **6SN11 62-0BA04-0AA1** | – |
| | – | 18/ 36 A | 24/ 32 A | 6SN11 24-1AA00-0CA1 | **6SN11 62-0BA04-0FA1** | – |
| | – | 28/ 56 A | 30/ 51 A | 6SN11 24-1AA00-0DA1 | **6SN11 62-0BA04-0BA1** | – |
| | – | – | 45/ 76 A | 6SN11 24-1AA00-0LA1 | **6SN11 62-0BA04-0CA1** | – |
| | – | 56/112 A | 60/102 A | 6SN11 24-1AA00-0EA1 | **6SN11 62-0BA04-0CA1** | – |
| | – | 70/140 A | 85/127 A | 6SN11 24-1AA01-0FA1 | **6SN11 62-0BA04-0EA0** | – |
| | – | – | 120/193 A | 6SN11 24-1AA00-0JA1 | **6SN11 62-0BA04-0EA0** | – |
| | – | 140/210 A | 200/257 A | 6SN11 24-1AA00-0KA1 | **6SN11 62-0BA04-0EA0** | – |
| | – | 2 x 3/ 6 A | 2 x 3/ 8 A | 6SN11 24-1AB00-0HA1 | **6SN11 62-0BA04-0AA1** | – |
| | – | 2 x 5/10 A | 2 x 5/ 8 A | 6SN11 24-1AB00-0AA1 | **6SN11 62-0BA04-0AA1** | – |
| | – | 2 x 9/18 A | 2 x 8/16 A | 6SN11 24-1AB00-0BA1 | **6SN11 62-0BA04-0AA1** | – |
| | – | 2 x 18/36 A | on request | 6SN11 24-1AB00-0CA1 | **6SN11 62-0BA04-0GA1** | – |
| | **Note:** The mounting frame can be omitted if the openings required for the modules are made as specified in chapter 6 in the cabinet rear panel. A **blanking plate** (width 1.970 in [50 mm]) can be supplied to cover the prepared opening: Order No.: 6SN11 62-0BA04-0JA0. The above-mentioned mounting frame must be used with modules that are 11.820 in (300 mm) wide. | | | | | |
| **Blanking plate** for mounting the module and covering the prepared opening for the external cooling | – | – | – | – | **6SN11 62-0BA04-0JA0** | 1.97 (50) |

## Hose (pipe) cooling

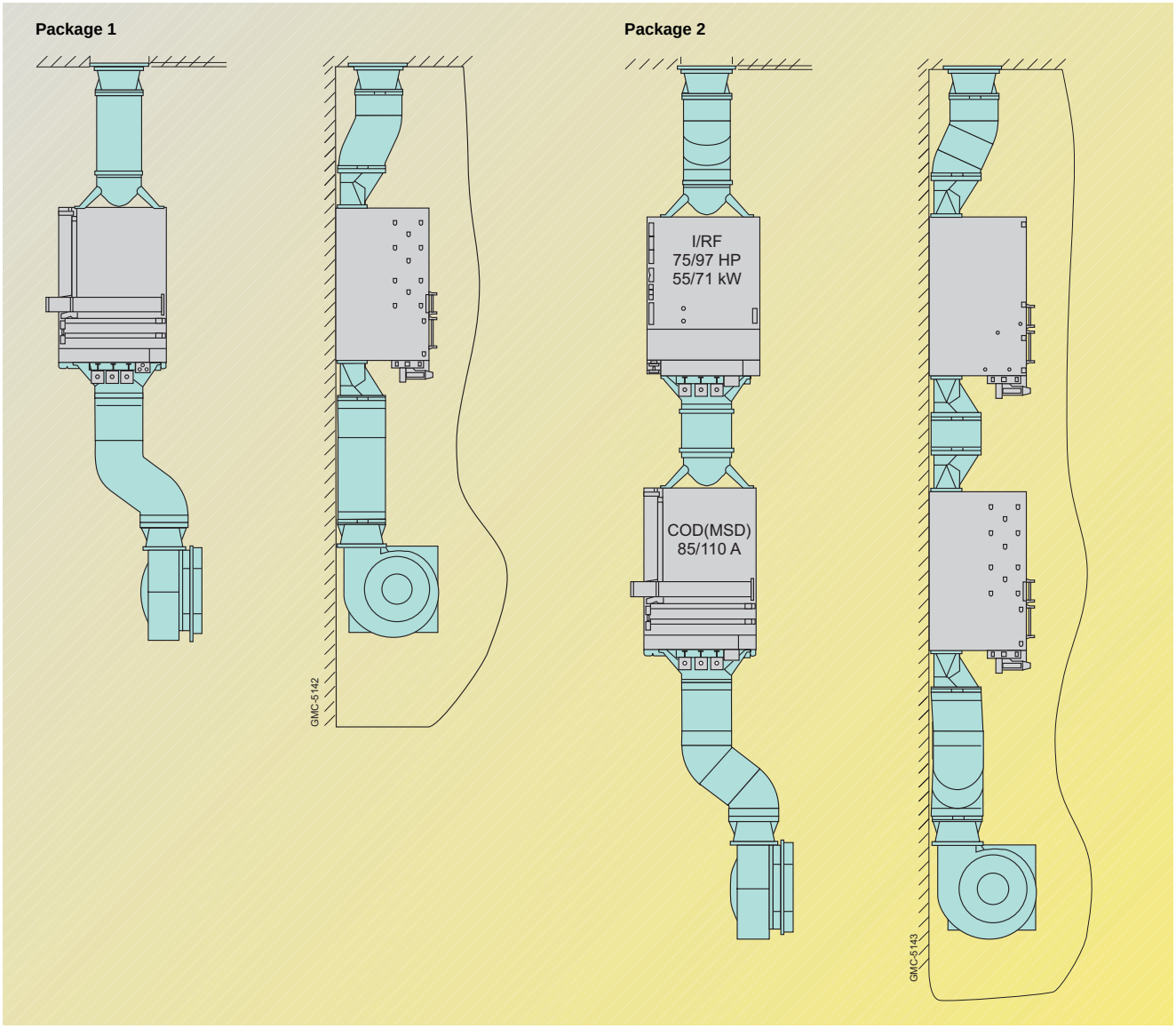



Fig. 3/3
Hose (pipe) cooling package 1 and 2.
Without infeed and power modules!

| Designation | | Order No. | |
|---|---|---|---|
| **Hose cooling packages** | • **Package 1**<br>for single module consisting of<br>2 x module connection flange 6 ft 7 in (2000 mm) hose 1 x cabinet connection flange<br>1 x radial fan with cabinet connection flange<br>360 V to 457 V 3-phase AC 47.5 Hz to 62.5 Hz<br>Connection current: 1 A to 1.2 A | **6SN11 62-0BA03-0AA1** | **Note:**<br>A 2-tier installation is permissible for the 75 HP (55 kW) I/RF module in combination with the 85 A power module. A hose connection assembly kit 6SN11 62-0BA03-0CA1 can be supplied for this purpose. |
| | • **Package 2**<br>for 2-tier configuration of 75 HP (55 kW) I/RF and LT 85 A consisting of<br>4 x module connection flange 6 ft 7 in (2000 mm) hose<br>1 x cabinet connection flange<br>1 x radial fan like Package 1 | **6SN11 62-0BA03-0CA1** | |

## Fan for internal and external cooling

| Designation | | Order No. | Degree of protection | Rated supply voltage | Connection current |
|---|---|---|---|---|---|
| **Built-on fan** | Radial blower for internal and external cooling | **6SN11 62-0BA02-0AA1** | IP 44 | 360 V to 510 V 3-phase AC 45 Hz to 65 Hz | 0.2 to 0.3 A |
| | | | **Note:** A built-on fan 6SN11 62-0BA02-0AA1 is required for several 11.820 in (300 mm) modules for the internal cooling (see power and infeed modules in this chapter). For external cooling, the fan box is part of the scope of supply of the mounting frame for the 11.820 in (300 mm) module width. The required 6SN11 62-0BA02-0AA1 built-on fan must be ordered separately. | | | |

## Shield terminal plate

| Designation | | Order No. | Module width in (mm) |
|---|---|---|---|
| **Shield terminal plate** | For O/I (aka. U/E) module 6.5 HP (5 kW), monitoring module and pulsed resistor module | **6SN11 62-0EB00-0AA0** | 1.97 (50) |
| | For O/I (aka. U/E) module 13.5 HP (10 kW) | **6SN11 62-0EB00-0BA0** | 3.94 (100) |
| | For O/I (aka. U/E) module 38 HP (28 kW), I/RF (aka. I/R) modules and power modules with: | | |
| | • **Internal cooling** | **6SN11 62-0EA00-0AA0** | 1.97 (50) |
| | | **6SN11 62-0EA00-0BA0** | 3.94 (100) |
| | | **6SN11 62-0EA00-0CA0** | 5.91 (150) |
| | | **6SN11 62-0EA00-0JA0** | 7.88 (200) |
| | | **6SN11 62-0EA00-0DA0** | 11.82 (300) |
| | • **External cooling** | **6SN11 62-0EB00-0AA0** | 1.97 (50) |
| | | **6SN11 62-0EB00-0BA0** | 3.94 (100) |
| | | **6SN11 62-0EB00-0CA0** | 5.91 (150) |
| | | **6SN11 62-0EB00-0JA0** | 7.88 (200) |
| | | **6SN11 62-0EB00-0DA0** | 11.82 (300) |
| | For modules with hose cooling or internal cooling with built-on fan | **6SN11 62-0EA00-0KA0** | 11.82 (300) |
| **Thermally conductive cover** | | **6SN11 62-0BA01-0AA0** | |
| | | **Note:** Unregulated control infeed modules are available for low outputs. These modules up to 13.5 HP (10 kW) contain the commutation reactor and a pulsed resistor which converts the braking energy of the drive modules into heat. With maximum capacity utilization of the pulsed resistor (>200 W), a thermally conductive cover must be used in order to keep the heat away from the modules located above. | |

## HF commutating reactors, supply voltage 400/480 V 3-phase AC

| Assignment to mains infeed module HP (kW) | Order No. | Rated AC A | Power loss W | Max. conductor cross-section, primary/secondary side AWG (mm²) | Weight, approx. lb (kg) | Dimensions (W x H x D) approx. in (mm) |
|---|---|---|---|---|---|---|
| **38 (28)** (O/I) | **6SN11 11-1AA00-0CA0** | 65 | 70 | 1 (50) | 13.2 (6) | 7.41 x 7.8 x 3.9 (190 x 200 x 100) |
| **22 (16)** (I/RF) | **6SN11 11-0AA00-0BA1** | 30 | 170 | 6 (16) | 18.7 (8.5) | 12.87 x 5.65 x 5.85 (330 x 145 x 150) |
| **49 (36)** (I/RF) | **6SN11 11-0AA00-0CA1** | 67 | 250 | 1 (50) | 28.6 (13) | 12.87 x 8.97 x 5.85 (330 x 230 x 150) |
| **75 (55)** (I/RF) | **6SN11 11-0AA00-0DA1** | 103 | 350 | 210 (70) | 39.6 (18) | 12.87 x 10.92 x 5.85 (330 x 280 x 150) |
| **109 (80)** (I/RF) | **6SN11 11-0AA00-0EA1** | 150 | 450 | FL[1]) | 88 (40) | 14.82 x 9.75 x 6.63 (380 x 250 x 170) |
| **160 (120)** (I/RF) | **6SN11 11-0AA00-1FA0** | 225 | 590 | FL[1]) | 110 (50) | 14.82 x 11.32 x 6.63 (380 x 290 x 170) |

## Mains filters

| Assignment to mains infeed module HP kW | Order No. | Rated AC A | Power loss W | Max. conductor cross-section, primary/secondary side AWG (mm²) | Equipotential connection (PE) GND | Weight, approx. lb (kg) | Dimensions (W x H x D) approx. in (mm) |
|---|---|---|---|---|---|---|---|
| **6.5 (5)** (O/I) | **6SN11 11-0AA01-1BA0** | 16 | 20 | 12 (4) | M 6, stud | 8.36 (3.8) | 6.08 x 7.52 x 3.15 (156 x 193 x 81) |
| **13.5 (10)** (O/I) | **6SN11 11-0AA01-1AA0** | 25 | 20 | 8 (10) | M 6, stud | 12.54 (5.7) | 6.08 x 10.95 x 3.54 (156 x 281 x 91) |
| **38 (28)** (O/I) | **6SN11 11-0AA01-1CA0** | 65 | 25 | 1 (50) | M 10, stud | 27.5 (12.5) | 6.66 x 10.17 x 5.49 (171 x 261 x 141) |
| **22 (16)** (I/RF) | **6SN11 11-0AA01-2BA0** | 30 | 70 | 8 (10) | M 5, stud | 19.8 (9) | 5.07 x 18.72 x 5.83 (130 x 480 x 149.5) |
| **49 (36)** (I/RF) | **6SN11 11-0AA01-2CA0** | 67 | 90 | 1 (50) | M 8, stud | 35.2 (16) | 5.07 x 18.72 x 9.53 (130 x 480 x 244.5) |
| **75 (55)** (I/RF) | **6SN11 11-0AA01-2DA0** | 103 | 110 | 1 (50) | M 8, stud | 41.8 (19) | 5.07 x 18.72 x 10.90 (130 x 480 x 279.5) |
| **109 (80)** (I/RF) | **6SN11 11-0AA01-2EA0** | 150 | 150 | 310 (95) | M 8, stud | 48.4 (22) | 7.8 x 18.72 x 10.90 (200 x 480 x 279.5) |
| **160 (120)** (I/RF) | **6SN11 11-0AA01-2FA0** | 225 | 200 | FL[1]) | M 10, stud | 70.4 (32) | 11.7 x 18.72 x 10.90 (300 x 480 x 279.5) |

## Mains filters package

**We mainly recommend ordering mains filter packages for I/RF modules.**

- Adapter sets are available to adapt the mains filter packages to the assembly surface of the filter modules. The mounted depth juts out of the front plane of the drive group by 0.788 in (20 mm) to 1.182 in (30 mm).

| Assignment to I/RF infeed module HP (kW) | **Mains filter package** Order No. | **Adapter set** Order No. |
|---|---|---|
| **22 (16)** | **6SN11 11-0AA01-2BB0** | **6SN11 62-0GA00-0BA0** |
| **49 (36)** | **6SN11 11-0AA01-2CB0** | **6SN11 62-0GA00-0CA0** |
| **75 (55)** | **6SN11 11-0AA01-2DB0** | **6SN11 62-0GA00-0DA0** |
| **109 (80)** | **6SN11 11-0AA01-2EB0** | **6SN11 62-0GA00-0EA0** |
| **160 (120)** | **6SN11 11-0AA01-2FB0** | **6SN11 62-0GA00-0EA0** |

1) FL = Flat termination, 0.355 in (9 mm) hole diameter.

## Demo unit

Demo unit SIMODRIVE 611 universal:

- in aluminium enclosure (with wheels)
- O/I infeed module 6.5 HP (5 kW)
- 2-axis plug-in unit with resolver feedback
- PROFIBUS-DP extension board
- Two 1FK6 motors with resolver
- Start-up box
- With transformer for 110 V 60 Hz power supply

### *Technical data*

| Designation | Value |
|---|---|
| Size (L x W x H) | 22 in x 10.5 in x 31 in (558 mm x 267 mm x 787 mm) |
| Weight | 90 lb (41 kg) |
| Voltage supply | 110 V 60 Hz, 1-phase |

### *Ordering data*

| Designation | Order No. |
|---|---|
| **Demo unit** | **6SN11 82-0TA00-2DP0-Z** |

Fig. 3/4
Demo unit

## Start-up box

The start-up box is a support device for starting up and servicing SIMODRIVE 611 universal controllers.

The start-up box can be connected to the plug-in unit. An electronic circuit within the device is used for converting the 24 V DC auxiliary power supply value of the converter into an analog setpoint. The analog setpoint can be adjusted and is displayed via a 5-digit LCD.

Performance characteristics of the start-up box

- Analog setting of setpoints:
  - coarse and fine setting by means of two potentiometers in the ratio 1 : 10
  - polarity selector switch between normal and inverse setpoint polarity
  - potentiometer for analog offset value with autonomous ON/OFF switch
  - ON/OFF switch for setting analog setpoints
- The analog setpoint is extensively decoupled and protected against pole-switching within the operating voltage range.
- The analog output signal of the control terminal strip is wired to 2 mm measuring sockets in the start-up box.
- Six OFF switches for digital enabling signals, with green LED indicator lamps.
- Four red LEDs for displaying digital output signals.

Fig. 3/5
Start-up box

### *Technical data*

| Designation | Value |
|---|---|
| Size (L x W x H) | 6.9 in x 3.5 in x 1.8 in (175 mm x 90 mm x 45 mm) |
| Voltage supply | 24 V DC (via terminal – X101) |
| Voltage range, analog setpoint | 0 V to 12.5 V/10 mA |
| Length of signal cable | 4.3 ft (1.3 m) |

### *Ordering data*

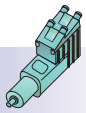
| Designation | Order No. |
|---|---|
| **Start-up box** | **9AK1014-1AA00** |

## Training courses

Contact Siemens Energy & Automation Training at www.aut.sea.siemens.com/training.

## Intelligent positioning motor

SIMODRIVE POSMO A



### Scope of application

Intelligent positioning motor as decentralized node on PROFIBUS with following features:

- Power section and complete motion control in motor
- Link by means of communications and power bus

Typical applications:

- Positioning of formats or stops
- Positioning of process variables (e.g. by means of motor valves)

Areas of application include transfer lines and on production machinery in the packaging, wood, glass, printing and plastics industries, but also in medical diagnostics, such as positioning of adjustable operating tables or X-ray equipment.

Other features

- The link by means of the communications and power bus makes for a more straightforward machine infrastructure.
- Straightforward communications interface for incorporation into any PROFIBUS environment. Utilizes the straightforward PROFIBUS services only.
- Two terminals (can be parameterized either as inputs or outputs) for monitoring or control of external drive-related signals, such as terminals or limit switches.
- Comprehensive range of examples makes for more straightforward configuration using STEP 7 in the SIMATIC environment.
- Straightforward start-up by adjustment of just a few factory-preset parameters.

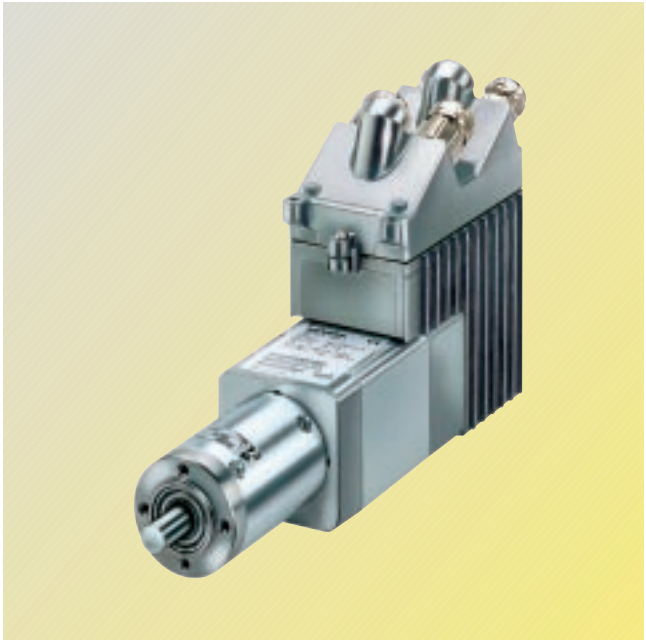


Fig. 3/6
SIMODRIVE POSMO A



### Mounting

Compact mounting of converter power section, motor control, encoder, positioning control, program memory and communications interface on the motor. The motor can be equipped with graduated planetary gearing from a modular gearbox.

- The removable terminal cover with integral PROFIBUS address switch and terminating resistor makes it possible to disconnect the motor without any interruption to communications.
- All connections are made using standard cables.
- Local diagnostics by means of LED (fault/ready), plus two diagnostic socket connectors (parameterizable analog outputs).

### Mode of operation

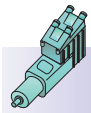
1-axis positioning drive
The drive power is provided by a supply voltage of 24 V DC, conventional in mechanical engineering. PROFIBUS provides the full range of travel functions, such as:

- **travel to**
  End position, with velocity and adjustable acceleration
- **travel around**
  One path and direction, with velocity and adjustable acceleration
- **travel with**
  Controlled speed

**Other functions:**

- jerk limitation
- on-the-fly block change
- actual value preset
- travel to fixed stop
- backlash compensation
- software limit switches

The PROFIBUS makes for high-speed cyclical data transfer between the slave and higher-level PROFIBUS master, e.g. a SIMATIC S7 central processing unit, a communications processor with master capability, such as the CP 5412, or a communications module, such as the CP 342-5, although standard masters produced by other manufacturers can also be used.

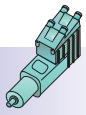




## POSMO A 0.1 HP (75 W) ($I_n$ = 4.5 A, $P_n$ = 0.084 HP/62 W)

| Order No. | Rated continuous output speed<br>rpm | Available torque at continuous operation<br>lb$_f$-in (Nm) | Gearbox type | Stage number | Ratio | Gearbox Efficiency | Permissible continuous gearbox torque[1]<br>lb$_f$ (Nm) | Max. available overload torque<br>lb$_f$-in (Nm) | Moment of inertia<br>lb-in$^2$ ($10^{-6}$ kgm$^2$) | Weight, approx.<br>lb (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| **6SN21 32-0AA11-1BA0** | 3300 | 1.6 (0.18) | None | – | 1 | 1 | – | 3.2 (0.36) | 0.01708 (60) | 6.84 (3.1) |
| **6SN21 32-1BC11-1BA0** | 667 | 6.2 (0.7) | Planetary gearbox PLG 52 (Play 1°) | 1 | 4.5 | 0.85 | 10.6 (1.2) | 12.4 (1.4) | 0.01734 (60.9) | 7.72 (3.5) |
| **6SN21 32-1BF11-1BA0** | 413 | 10.6 (1.2) | | 1 | 8 | 0.85 | 10.6 (1.2) | 21.2 (2.4) | 0.01734 (60.9) | 7.72 (3.5) |
| **6SN21 32-1CK11-1BA0** | 148 | 23.0 (2.6) | | 2 | 20.25 | 0.72 | 70.8 (8.0) | 46.0 (5.2) | 0.01734 (60.9) | 8.2 (3.7) |
| **6SN21 32-1CR11-1BA0** | 83 | 41.6 (4.7) | | 2 | 36 | 0.72 | 70.8 (8.0) | 82.3 (9.3) | 0.01734 (60.9) | 8.2 (3.7) |
| **6SN21 32-1CU11-1BA0** | 60 | 57.5 (6.5) | | 2 | 50 | 0.72 | 70.8 (8.0) | 115 (13.0) | 0.01734 (60.9) | 8.2 (3.7) |
| **6SN21 32-1DE11-1BA0** | 24 | 123 (13.9) | Planetary gearbox PLG 52 (Play 1.5°) | 3 | 126.26 | 0.61 | 212 (24) | 246 (27.8) | 0.01734 (60.9) | 8.6 (3.9) |
| **6SN21 32-1DH11-1BA0** | 19 | 158 (17.8) | | 3 | 162 | 0.61 | 212 (24) | 315 (35.6) | 0.01734 (60.9) | 8.9 (3.6) |
| **6SN21 32-5KD11-1BA0** | 600 | 5.3 (0.6) | Worm gear SG80 | 1 | 5 | 0.70 | 17.7 (2.0) | 11.5 (1.3) | 0.01751 (61.5) | 7.72 (3.5) |
| **6SN21 32-5KM11-1BA0** | 125 | 19.5 (2.2) | | 1 | 24 | 0.50 | 31.0 (3.5) | 38.1 (4.3) | 0.01751 (61.5) | 7.72 (3.5) |

1) The specified values are continuous torques. The gearboxes may be briefly subject to higher torques up to a maximum of twice the continuous torque without gearboxes being damaged. The gearbox could be destroyed if this limit is exceeded.



## PROFIBUS LAN cables and connectors[1])

SIMODRIVE POSMO A is controlled and parameterized via PROFIBUS-DP. Stand-alone operation with up to 4 individually selectable traversing blocks is possible in case the communication is lost. However, to parameterize these traversing blocks, a PROFIBUS connection incl. PROFIBUS cables and connectors is needed.

Different types of PROFIBUS cables are available for various installation applications, e.g. trailing cables, robust cables etc. (for more information refer to chapter 2 or the Siemens catalog IK 10 and the electronic catalog CA01). Generally the cables listed should be used. Due to double-shielding these cables are particularly suitable for industrial environments subject to electromagnetic interference.
PROFIBUS FastConnect (FC) is a system for fast and easy assembly of PROFIBUS copper cables. The system comprises 3 compatible components:

- FastConnect bus cables for rapid installation
- FastConnect stripping tool
- FastConnect bus connector for PROFIBUS.

| Description | | Order No. |
|---|---|---|
| **PROFIBUS FC Standard Cable** | Standard type, specially designed for rapid assembly, two-wire, shielded, sold by the meter; consignment 3280 ft (1000 m) max., min. ordering quantity 65.6 ft (20 m) | **6XV18 30-0EH10** |
| | **Preferred lengths** | |
| | 65.6 ft (20 m) | **6XV18 30-0EN20** |
| | 164 ft (50 m) | **6XV18 30-0EN50** |
| | 328 ft (100 m) | **6XV18 30-0ET10** |
| | 656 ft (200 m) | **6XV18 30-0ET20** |
| | 1640 ft (500 m) | **6XV18 30-0ET50** |
| **PROFIBUS FC Robust Cable** | Two-wire, shielded, sold by the meter; consignment 3280 ft (1000 m) max., min. ordering quantity 656 ft (20 m) | **6XV18 30-0JH10** |
| **PROFIBUS FC Trailing Cable** | Two-wire, shielded, sold by the meter; consignment 3281 ft (1000 m) max., min. ordering quantity 65.6 ft (20 m) | **6XV18 30-3EH10** |
| **PROFIBUS FastConnect** | **Stripping tool**<br>Preset stripping tool for rapid stripping of insulation from PROFIBUS Fast Connect bus cables | **6GK19 05-6AA00** |
| | **Blade Cassettes**<br>Spare blade cassettes for the PROFIBUS FastConnect stripping tool, 5 pieces | **6GK19 05-6AB00** |
| **PROFIBUS FastConnect bus** | **Connector RS 485 with 90° cable outlet**<br>With insulation displacement technique | |
| | • without PG interface | **6ES79 72-0BA50-0XA0** |
| | • with PG interface[2]) | **6ES79 72-0BB50-0XA0** |
| | **Connector RS 485 with 180° cable outlet**<br>Plug 180 | **6GK15 00-0FC00** |

## Power cable

The maximum connectable cable cross-section to the POSMO A 0.1 HP (75 W) is AWG 12 (4 mm$^2$). The cable outside diameter must be between 0.315" (8 mm) and 0.472" (12 mm) to guarantee IP 55 degree of protection.

Shielding of the cable is recommended but not required. It can be used any 2 lead that adhere to the above mentioned limits. The 6FX50 08-5FA00-1FA0 cable is recommended.

The power for the electronics is supplied by the main power, however if bus communications and positioning sensing are to remain active even with the load power supply powered down, an optional electronics power supply can be connected (24 V ±20%).

The power leads are routed together with the PROFIBUS Cable 6ES71 94-1LY00-0AA0 or the oil resistant 6ES71 94-1LY10-0AA0.

| Designation | Current capacity[3]) | Cross-section | Outside cable diameter | Order No. | Weight | Length |
|---|---|---|---|---|---|---|
| | A | AWG (mm$^2$) | in (mm) | | lb/ft (kg/m) | ft (m) |
| **Power cable** | 31 | 2 x AWG 12 (2 x 4 mm$^2$) | 0.42" (10.7) | **6FX50 08-5FA00-1FA0** | 0.118 (0.176) | 164 (50) |
| **Power cable PVC sheath** | 5 | 1 x 2 x AWG 19 (1 x 2 x 0.65 mm$^2$) 3 x 1 x AWG 18 (3 x 1 x 0.75 mm$^2$) | 0.374 ± 0.02 (9.5 ± 0.5) | **6ES71 94-1LY00-0AA0-Z**[4]) | 0.071 (0.232) | Sold by meter |
| **Power cable Oil resistant PUR sheath** | 5 | 1 x 2 x AWG 19 (1 x 2 x 0.65 mm$^2$) 3 x 1 x AWG 18 (3 x 1 x 0.75 mm$^2$) | 0.374 ± 0.02 (9.5 ± 0.5) | **6ES71 94-1LY10-0AA0-Z**[4]) | 0.071 (0.232) | Sold by meter |

1) PROFIBUS cables and connectors have been included for your convenience, please order through your automation product channel.

2) D-Sub female connector on back of plug, allows to piggyback second connector.

3) According to IEC 60 204-1 1997 corrigendum 1998, at +104 °F (40 °C), installation condition C.

4) This automation product has been included for your convenience, please order through your automation product channels.

## Power Management Module DC-PMM 24 V

The DC-PMM/24 V is installed between one or more positioning motors (POSMO A) and the load power supply, and is used as feedback protection for the latter. The PMM detects when the positioning motor brakes and uses an impulse resistor to eliminate the feedback energy from the motor.

An integrated $I^2t$ monitor protects the impulse resistor against thermal overloading, thus preventing damage to the resistor. The relay contacts of the PMM are used as signaling and monitoring contacts for the operating states “Ready” and “Fault”.

| Designation | Order No. |
|---|---|
| **Power Management Module (DC-PMM/24 V)** | **9AL21 37-1AA00-1AA0** |

Fig. 3/7
Power Management Module

## Demonstration units

There is a single and a two-axis demonstration unit for the SIMODRIVE POSMO A available.

***1-axis unit equipped with:***

- SIMODRIVE POSMO A
- SITOP power supply
- Power Management Module (PMM)
- Power outlet (US standard)
- 1-ph. 120 V
- Dimensions (W x H x D): 19.9 in x 15.8 in x 7.1 in (500 mm x 400 mm x 180 mm)
- Weight: 44.1 lb (20 kg)

| Designation | Order No. |
|---|---|
| **Demonstration unit 1-axis unit** | **6SN28 92-0PG00-0AA0** |

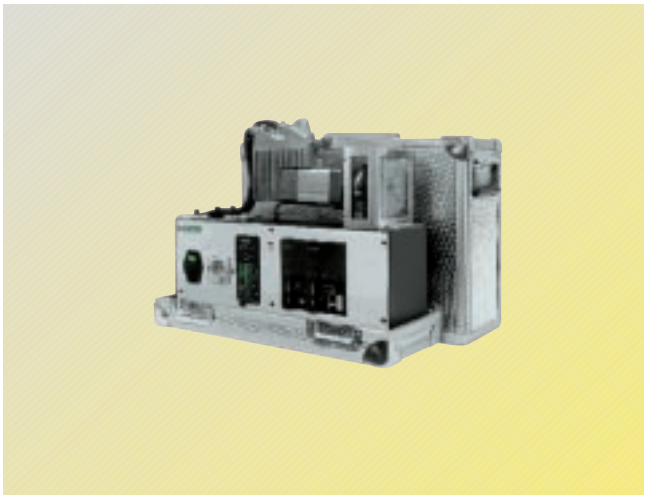


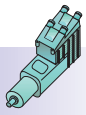
Fig. 3/8
Demonstration unit, 1-axis

***2-axis unit equipped with:***

- 2 SIMODRIVE POSMO A 0.1 HP (75 W)
- 2 SITOP power supply
- Power Management Module (PMM)
- SIMATIC C7 626-DP PLC
- Preinstalled communication program via PROTOOL on C7.
- Power outlet (US standard)
- 1-ph. 120 V
- All accessories (cables, connectors)
- Software: S7-project with integrated PROTOOL. Different screen forms on C7 for parameter setting, MDI-input, jogging, referencing, display control word, status word PROFIBUS.
- Dimensions (W x H x D): 13 in x 20 in x 17.3 in (330 mm x 500 mm x 440 mm)
- Weight: 70.6 lb (32 kg)

| Designation | Order No. |
|---|---|
| **Demonstration unit 2-axis unit** | **6SN28 32-0CF00-0AA0** |

Fig. 3/9
Demonstration unit, 2-axis



## SITOP power

The SITOP range of 24 V power supplies has been optimized for industrial applications and operates on the primary pulse principle. The precise regulation of the output voltage makes the devices suitable even for connection to sensitive sensors.

DC/DC transformers with 600 V inputs have been developed specifically for connection to converters with a DC link. The drive energy can be used to provide a continued supply to 24 V loads, even after a power failure; appropriate safety measures can therefore be implemented.

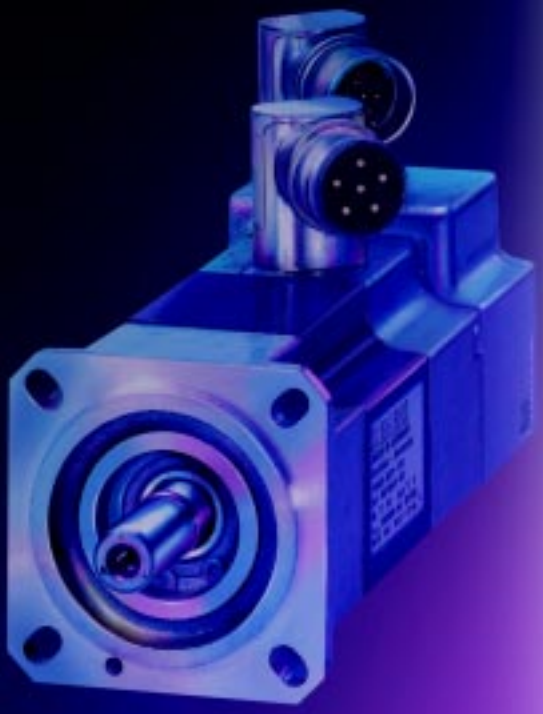
10 A and 40 A DC USV modules with external battery back-up are available to provide protection against lengthy power failures.

***Technical features***

- Precise output voltage
- Low residual ripple
- Large input voltage range
- High utilization factor
- Straightforward assembly
- Integrated electronic short-circuit protection
- Safe electrical isolation (SELV in accordance with EN 60 950)
- Comply with national and international standards, e.g. EMC in accordance with EN 50 081-1/-2 and EN 50 082-1/-2; UL/cUL approval
- No silicone release

| Version | Input<br>Voltage<br>$U_{e\ rated}$ | Order No. | Voltage range | Output<br>Voltage<br>$U_{a\ rated}$ | Current<br>$I_{a\ rated}$ |
|---|---|---|---|---|---|
| **24 V DC/2 A; 5 A; 10 A; 20 A 1-phase $c^{UL}_{US}$ [1]** | | | | | |
| | 120 V/230 V AC | **6EP13 31-2BA00** | 93 V – 132 V AC/<br>187 V – 264 V AC | 24 V DC<br>± 3 % | 2 A |
| | 120 V/230 V AC | **6EP13 33-2BA00** | 93 V – 132 V AC/<br>187 V – 264 V AC | 24 V DC<br>± 3 % | 5 A |
| | 120 V/230 V AC | **6EP13 34-2BA00** | 93 V – 132 V AC/<br>187 V – 264 V AC | 24 V DC<br>± 3 % | 10 A |
| | 120 V/230 V AC | **6EP13 36-2BA00** | 93 V – 132 V AC/<br>187 V – 264 V AC | 24 V DC<br>± 1 % | 20 A |
| **24 V DC/10 A; 20 A; 30 A; 40 A 3-phase $c^{UL}_{US}$ [1]** | | | | | |
| | 3-ph. 400 V – 500 V AC | **6EP14 34-2BA00** | 3-ph. 360 V – 550 V AC | 24 V DC<br>± 3 % | 10 A |
| | 3-ph. 400 V – 500 V AC | **6EP14 36-2BA00** | 3-ph. 360 V – 550 V AC | 24 V DC<br>± 3 % | 20 A |
| | 3-ph. 400 V – 500 V AC | **6EP14 37-2BA00** | 3-ph. 360 V – 550 V AC | 24 V DC<br>± 3 % | 30 A |
| | 3-ph. 400 V – 500 V AC | **6EP14 37-2BA10** | 3-ph. 360 V – 550 V AC | 24 V DC<br>± 3 % | 40 A |

1) SITOP power supplies are part of the Siemens Industrial Product Division in Batavia, Illinois, please use your Products Division sales channel to order this product.



# SIMODRIVE 611 universal POSMO A

# Motor Selection

**Efficiencies for synchronous Siemens High Performance Motors**

4/2 1FK6 Standard
4/2 1FT6 Water-cooled
4/2 1FT6 Self-cooled

**For all other motor information see Catalog General Motion Control Catalog Part 2 High Performance Motors and Accessories**

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# Motor Selection

## Efficiencies for synchronous Siemens High Performance Motors



### 1FK6 Standard

| Motor | Winding / Speed F 3000 rpm | K 6000 rpm |
|---|---|---|
| 1FK6032-..□.. | – | 81 % |
| 1FK6040-..□.. | – | 80 % |
| 1FK6042-..□.. | 86 % | – |
| 1FK6060-..□.. | 87 % | – |
| 1FK6063-..□.. | 89 % | – |
| 1FK6080-..□.. | 89 % | – |
| 1FK6083-..□.. | 90 % | – |
| 1FK6100-..□.. | 92 % | – |
| 1FK6101-..□.. | 92 % | – |
| 1FK6103-..□.. | 92 % | – |

### 1FT6 Water-cooled

| Motor | Winding / Speed B 1500 rpm | C 2000 rpm | F 3000 rpm | H 4500 rpm | K 6000 rpm |
|---|---|---|---|---|---|
| 1FT6084-.S□.. | – | – | 91 % | 91 % | 91 % |
| 1FT6086-.S□.. | – | – | 91 % | 93 % | 91 % |
| 1FT6105-.S□.. | 92 % | 93 % | 94 % | – | – |
| 1FT6108-.S□.. | 93 % | 94 % | – | – | – |
| 1FT6132-.S□.. | 93 % | 94 % | 95 % | – | – |
| 1FT6134-.S□.. | 94 % | 95 % | 96 % | – | – |
| 1FT6136-.S□.. | 94 % | 95 % | – | – | – |

### 1FT6 Self-cooled

| Motor | Winding / Speed B 1500 rpm | C 2000 rpm | F 3000 rpm | H 4500 rpm | K 6000 rpm |
|---|---|---|---|---|---|
| 1FT6031-.A□.. | – | – | – | – | 87 % |
| 1FT6034-.A□.. | – | – | – | – | 89 % |
| 1FT6041-.A□.. | – | – | 85 % | – | 88 % |
| 1FT6044-.A□.. | – | – | 88 % | – | 89 % |
| 1FT6061-.A□.. | – | 82 % | 86 % | 88 % | 87 % |
| 1FT6062-.A□.. | – | 84 % | 88 % | 89 % | – |
| 1FT6064-.A□.. | – | 87 % | 89 % | 89 % | – |
| 1FT6081-.A□.. | – | 85 % | 88 % | 89 % | 88 % |
| 1FT6082-.A□.. | – | 87 % | 90 % | 90 % | 88 % |
| 1FT6084-.A□.. | – | 90 % | 91 % | 88 % | – |
| 1FT6086-.A□.. | – | 90 % | 91 % | 90 % | – |
| 1FT6102-.A□.. | 92 % | 93 % | 94 % | 92 % | – |
| 1FT6105-.A□.. | 93 % | 94 % | 94 % | – | – |
| 1FT6108-.A□.. | 94 % | 94 % | – | – | – |
| 1FT6132-.A□.. | 94 % | 95 % | 94 % | – | – |
| 1FT6134-.A□.. | 95 % | 95 % | – | – | – |
| 1FT6136-.A□.. | 95 % | 95 % | – | – | – |

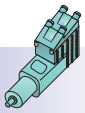
# SIMODRIVE 611 universal POSMO A Documentation

**Overview**
5/2 General documentation
5/2 Manufacturer/Service documentation
5/2 Electronic documentation
5/2 Selection & ordering data

5

# Documentation

## Overview

SIMODRIVE POSMO A 

SIMODRIVE 611 universal

The documentation for the units (infeed modules, power modules, plug-in units), system components and options is supplied in German/English with the products which have been ordered.

SIMODRIVE documentation is structured as follows:

- General documentation
- Manufacturer/Service documentation
- Electronic documentation

### General documentation

These are used for selection and preliminary engineering information.

***General Motion Control Catalog Part 2 · 1999***

Catalog for High Performance Motors and Accessories

***General Motion Control Catalog Part 3 · 2001***

Catalog for SIMODRIVE 611 U and SIMODRIVE POSMO A

### Manufacturer/Service documentation

This documentation addresses machine OEMs and service personnel who wish to use "SIMODRIVE 611 universal" with standard rotating motors in the "speed/torque setpoint" mode.

***Description of Functions SIMODRIVE 611 universal***

This documentation addresses machine OEMs and service personnel who wish to use "SIMODRIVE 611 universal". This function description provides detailed information on the functionality of the "SIMODRIVE 611 universal" control board.

***Planning Guide SIMODRIVE 611***

This guide aids in the planning of an application and gives you detailed technical information for the "SIMODRIVE 611 universal".

***User Manual POSMO A***

This documentation addresses machine OEMs and service personnel who wish to use "SIMODRIVE POSMO A". This function description provides detailed information on the functionality of the "SIMODRIVE POSMO A".

### Electronic documentation

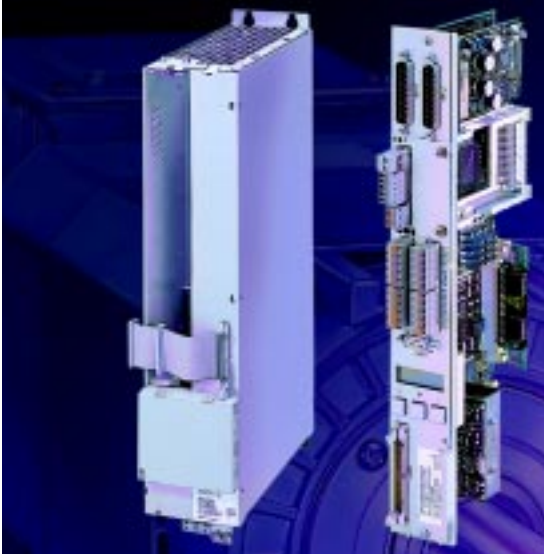
***General Motion Control CD***

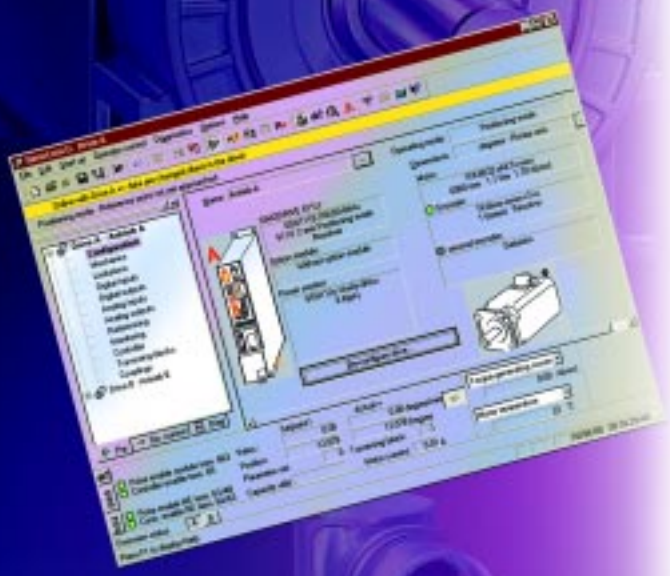
This CD, which is delivered with each unit, contains:

- SimoComU V3.x a drives configuration software for SIMODRIVE 611 universal
- Function blocks to talk PROFIBUS with a S7 master for SIMODRIVE 611 universal
- All documentation in PDF files
- SIMOSIZE E and much more

### Selection & ordering data

| Documentation | Order no. |
|---|---|
| **General documentation** | |
| General Motion Control Catalog Part 2 · 1999 | **DRSP-02062** |
| General Motion Control Catalog Part 3 · 2001 | **DRSP-02080** |
| **Manufacturer/Service documentation** | |
| Short guide SIMODRIVE 611 universal (Brief description) | **6SN11 97-0AB40-0BP2** |
| Description of functions SIMODRIVE 611 universal | **6SN11 97-0AB20-0BP2** |
| Planning guide SIMODRIVE 611 | **6SN11 97-0AA00-0BP4** |
| User Manual SIMODRIVE POSMO A, english | **6SN21 97-0AA00-0BP1** |
| **Electronic documentation** | |
| General Motion Control CD | **DRMS-02055** |





# SIMODRIVE 611 universal POSMO A

# Engineering Information


***SIMODRIVE 611 universal***

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***SIMODRIVE POSMO A***

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## Engineering instructions

### *Motion Control*

Servo drives are mostly cycle-type drives, i.e. drives which perform particular sequences of movement within a fixed cycle of motion. These movements can be linear or rotational. In addition, the motion sequence usually involves approaching a pre-defined position and all movements must be carried out in the shortest possible time. As a consequence, drives have to meet specific requirements. They must be

- dynamic, i.e. have short rise-times and move to the desired position without overshoot
- high overload capability, i.e. have a high acceleration reserve
- and must have a large control range, i.e. high resolution for exact positioning.

The planning notes below refer to servo drives with 1FK6/1FT6 synchronous servomotors, with 1PH7/1PH4/1PL6 induction servomotors or with 1FN3 linear motors.

Synchronous servomotors are preferred where a compact motor volume, low rotor inertia and fast response levels are important. With induction servomotors, high maximum speeds are reached in the field-weakened speed range. They have a somewhat larger motor volume.

The drives can be operated individually as single-axis drives or together as multi-axis drives. For connecting the drives to a PLC, via PROFIBUS, a supplementary board is necessary. Decentralized provision of positioning functions within the Motion Control system is possible with the software or the functions can be provided centrally using a higher level controller.

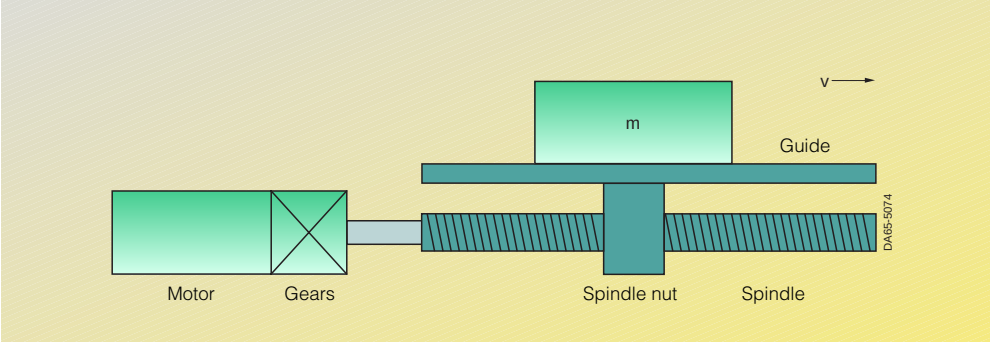


Fig. 6/1
Typical spindle drive

### *A typical planning sequence*

The basis for planning is the sketch and the description of how the machine functions.

1. Clarification of the type of drive, technical data and other border conditions such as technological functions and integration into an automation system
2. Specification of the motion curve
3. Calculation of the maximum load torque, selection of the gearbox
4. Selection of the motor
5. Cooling methods
6. Configuration of the drive module
7. Selection of the infeed module
8. Selection of the breaking unit and braking resistor
9. Selection of other components

1. Clarification of the type of drive, technical data and other border conditions

The procedure for calculating the load torque depends on the type of drive. It may be a traction drive, a lifting drive or a turntable drive. In the case of linear motion, for example, power can be transmitted via a toothed belt, a gear rack or a spindle. Normally, a gearbox is also needed for adapting the motor speed and the motor torque to the load conditions.

For this calculation, the following technical data must be available:

- The moving masses
- The diameter of the drive wheel or the diameter and pitch of the spindle
- Details of the frictional losses
- Mechanical efficiency
- The travel distances
- The maximum speed
- The maximum acceleration and the maximum deceleration
- The cycle time
- Accuracy levels for positioning

Further conditions are the integration into a system (PLC), the technology to be used (central or distributed) and the coupling between the drives (e.g. with PROFIBUS).

2. Specification of the motion curve

The motion curve – namely the $v,t$ diagram when a linear drive is being used – is determined from the information relating to travel distances, speed, acceleration, deceleration and the cycle time. If multi-axis drives are used, the interdependence of the individual motion curves must be taken into account. The motion curve is also required for thermally dimensioning the motor and selecting the braking resistor. It should therefore represent the "worst-case scenario" for the task.

### 3. Calculation of the load speed and the maximum load torque, selection of the gearbox

Information on the mechanical factors involved is used to calculate the load speed and the maximum load torque. If the deceleration is equal to the acceleration, the load torque is at a maximum during the acceleration phase. For selecting the gear, there are various other variables in addition to the maximum load torque. These are

- size
- efficiency
- torsional play
- torsional rigidity
- moment of inertia
- noise.

Planetary gears are especially suitable for positioning tasks due to their low torsional play and high torsional strength. These gears also have a high power density, are highly efficient and produce a low amount of noise. When the gear transmission ratio is being selected, it should be borne in mind that higher motor speeds generally entail smaller motors. This must, however, be checked for each individual case. A higher gear transmission ratio has a favourable effect on positioning accuracy in relation to the encoder resolution. The angle of rotation $\alpha_G$ of the gear, the number of pulses $z$ per rotation of the encoder, the drive-wheel diameter $D$ or the spindle pitch $h$ and the gear transmission ratio $i$ give the positioning accuracy as follows:

$$\Delta S_{Gear} = \frac{D \cdot \pi}{360°} \cdot \alpha_G$$

$$\Delta S_{Encoder} = \frac{D \cdot \pi}{i \cdot z}$$

or

$$\Delta S_{Encoder} = \frac{h}{i \cdot z} \text{ with spindle drives}$$

$$\Delta S_{total} = \Delta S_{Gear} + \Delta S_{Encoder} + \Delta S_{mech}$$
(steady – state)

$\Delta S_{mech}$ is the imprecision of the mechanical system such as due to expansion of the toothed belt.

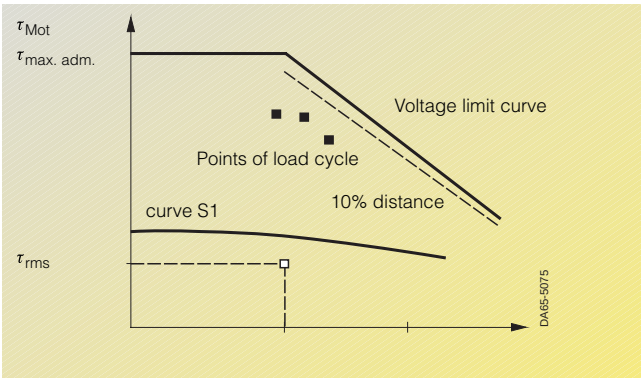


Fig. 6/2
Limit curves for 1FK6/1FT6 motors
(synchronous servomotors)

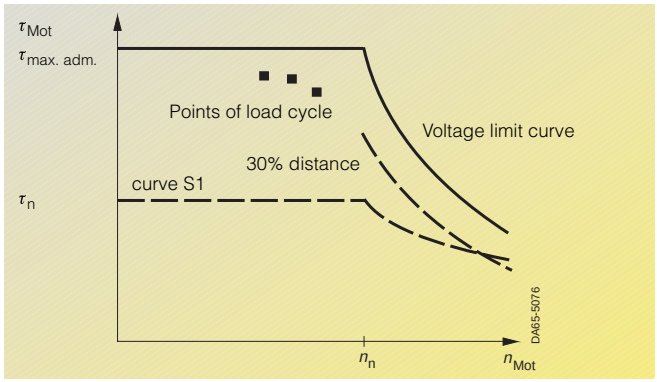


Fig. 6/3
Limit curves for 1PH7 motors
(induction servomotors)

### 4. Selection of the motor

The motor is selected according to the following criteria:

- Observing the dynamic limits, i.e. all $\tau_n$ points of the load cycle must be below the limit curve.
- The motor speed must be smaller than $n_{max\ perm.}$. With synchronous servomotors, the maximum motor speed must not be greater than the rated speed.
- Observing the thermal limits, i.e. with synchronous servomotors, the motor rms torque at the mean motor speed resulting from the load cycle must be below the S1 curve. With induction servomotors, the rms value of the motor current within a load cycle must be smaller than the rated current of the motor.

When synchronous servomotors are used, it must be borne in mind that the maximum permissible motor torque at high speeds is reduced by the voltage-limit curve. In addition, a margin of about 10% should be kept from the voltage-limit curve as a protection against voltage fluctuations.

If induction servomotors are used, the permissible motor torque in the field-weakening range is reduced by the stalling limit. Here, a clearance of approximately 30% should be maintained.

## Engineering instructions

In order to keep a check on the dynamic limits, the maximum motor torques must be calculated. In general, the maximum motor torque occurs during the acceleration phase. During acceleration, in addition to the maximum torque determined by the load, there is also the torque $\tau_{a\,Mot}$ needed for accelerating the rotor's moment of inertia. The following formula is therefore used to calculate the maximum motor torque:

$\tau_{Mot\,max} = \tau_{a\,Mot} + \tau_{*Load\,max}$

$\tau_{a\,Mot}$ Accelerating torque for the motor rotor

$\tau_{*Load\,max}$ The maximum load torque converted to the motor speed during the acceleration phase, including the contribution of the gearbox

with

$\tau_{a\,Mot} = J_{Mot} \cdot \alpha_{a\,Mot}$

$\alpha_{a\,Mot}$ Angular acceleration of the motor

By experimenting, a motor can now be found which fulfils the condition for the maximum motor torque in the required speed range. The proportion of the acceleration torque for the motor rotor in relation to the maximum motor torque depends not only on the motor's moment of inertia and the angular acceleration but also on the moment of inertia of the load, the gear transmission ratio and the static load torque.

A second point to be checked is whether the thermal limits are adhered to.

### *Synchronous servomotors*

In order to calculate the rms torque, the motor torque must be determined in all parts of the motion curve. The following formula is used to calculate the rms torque and the mean motor speed:

$$\tau_{rms} = \sqrt{\frac{\sum \tau^2_{Mot\,i} \cdot \Delta t_i}{T}}$$

$$n_{mean} = \frac{\sum \frac{|n_{Mot\,B} + n_{Mot\,E}|}{2} \cdot \Delta t_i}{T}$$

$T$ Cycle time

$\tau_{Mot\,i}$ Motor torque in time segment $\Delta t_i$

$\frac{|n_{Mot\,B} + n_{Mot\,E}|}{2}$ Mean motor speed in time segment $\Delta t_i$ (B: initial value, E: final value)

If the rms torque at the mean motor speed is below the S1 curve and the dynamic limits are being adhered to, the selected synchronous servomotor can be used.

### *Induction servomotors*

In order to calculate the motor's rms current, the motor torque in all parts of the motion curve must first be determined. The motor current is thus calculated as follows:

$$I_{Mot} = I_n \cdot \sqrt{\left(\frac{\tau_{Mot}}{\tau_n}\right)^2 \cdot \left(1 - \left(\frac{I_{\mu n}}{I_n}\right)^2\right) \cdot k_n^2 + \left(\frac{I_{\mu n}}{I_n}\right)^2 \cdot \frac{1}{k_n^2}}$$

$I_n$ Rated current

$I_{\mu n}$ Rated magnetizing current

$k_n = 1$ in the constant flux range

$k_n = \frac{n}{n_n}$ in the field-weakening range

The following formula is used to calculate the rms value of the motor current:

$$I_{rms} = \sqrt{\frac{\sum \left(\frac{I_{Mot\,B} + I_{Mot\,E}}{2}\right)^2 \cdot \Delta t_i}{T}}$$

$\frac{I_{Mot\,B} + I_{Mot\,E}}{2}$ Mean motor current in time segment $\Delta t_i$ (B: initial value, E: final value)

If the dynamic limits are adhered to and the rms value of the motor current is smaller than the motor's rated current, the selected induction motor can be used.

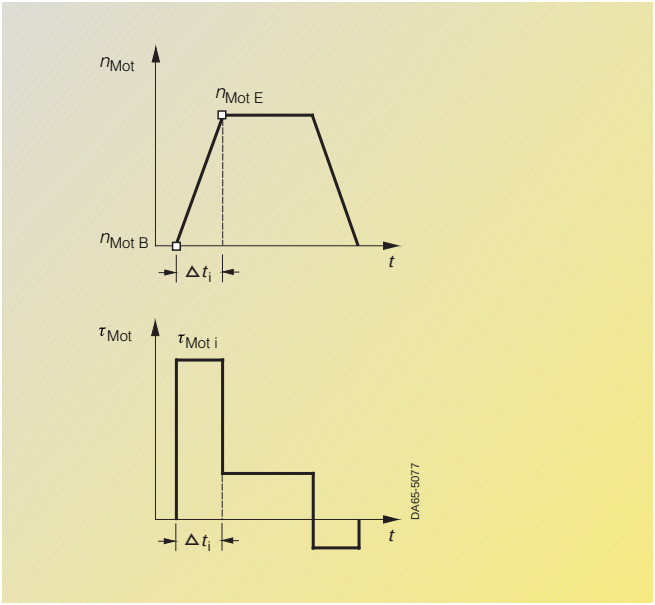


Fig. 6/4
Example of motor speed and motor torque in a time segment $\Delta t_i$

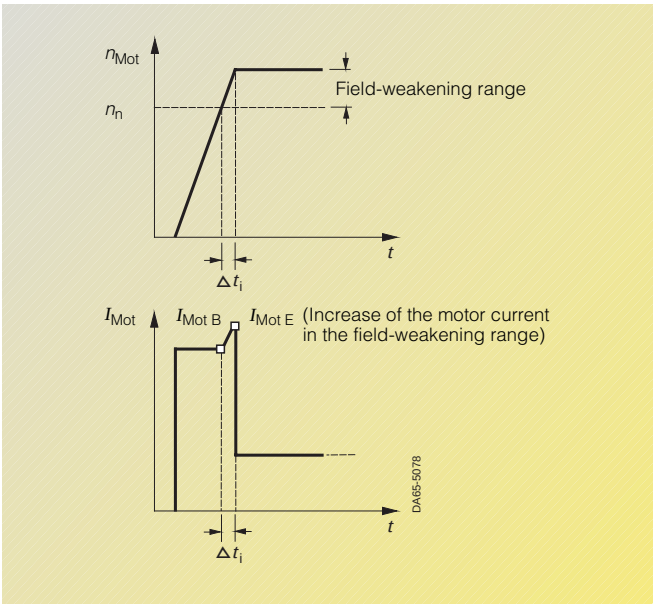


Fig. 6/5
Example of motor speed and motor torque in a time segment $\Delta t_i$

Which encoder is selected depends on the requirements in each case. Encoders provide high resolution and extremely true running at the lowest speeds. They are thus especially suitable for highly accurate positioning tasks. Resolvers are robust and inexpensive and provide good resolution.

### 5. Cooling methods

Different cooling methods are available for the infeed and power modules:

- Internal cooling
- External cooling
- Hose cooling

Internal cooling

In this standard solution, the power loss of the converter components from the electronic equipment and the power section is dissipated to the switching cabinet interior.

External cooling

Because the heat sinks of the modules pass through the mounting surface in the switching cabinet, the power loss of the power section can be dissipated to an external ventilation circuit. Only the power loss of the electronic equipment remains in the switching cabinet. Degree of protection IP 54 NEMA 12, can be attained at the “mechanical interface” which is the external heat sink.

Hose cooling

Hose cooling is designed for switching cabinets that do not have a separate ventilation channel for the power sections. Flexible tubes are used to remove the power loss of the power sections from the cabinet. Degree of protection IP 54 NEMA 12, can be attained at the “mechanical interface”.

### 6. Configuration of the drive modules

The drive modules comprise the power module, closed-loop control plug-in unit, unit/device bus cable and, in some cases, the option module.

Depending on the cooling method employed or the power module’s size, ventilation components have to be ordered additionally or provided by the user.

One (w. Resolver evaluation) and two axis (w. Resolver or sin/cos encoder evaluation) plug-in units and one or two-axis power modules are available. Both analog setpoint specification and serial communication via PROFIBUS-DP are possible.

Considerations for the power mudule with induction motors

The drive module with induction motor closed-loop control allows the use of converter-fed induction motors rated for a DC link voltage of 600 V. The maximum motor stator frequency is 1400 Hz for the SIMODRIVE 611 universal. With motor frequencies above 300 Hz or motor rated currents above 85 A, it may be necessary to provide a series inductor or increase the converter operating frequency. Note the rating guidelines given in the Planning Guide chapter 7.

In order to determine the motor current at a given motor torque, the following formula is used:

– For synchronous servomotors

$$I_{Mot} = \frac{\tau_{Mot}}{kTn}$$

$kTn$ Torque constant

In general, the maximum motor current occurs during the acceleration phase. At high motor torques, the motor current may be greater than calculated with $kTn$ due to saturation effects. This must be taken into account when dimensioning/selecting the motor.

– For induction servomotors

Calculation of the motor current is as described under step 4. Acceleration into the field-weakening range with a constant motor torque results in the maximum motor current in the field-weakening range at maximum speed.

The following formula is used to calculate the arithmetic mean of the motor current:

– For synchronous servo-motors

$$I_{Mot\ mean} = \frac{\sum |\tau_{Mot\ i}| \cdot \Delta t_i}{kTn \cdot T}$$

$\tau_{Mot\ i}$ Motor torque in time segment $\Delta t_i$

$T$ Cycle time, period

– For induction servomotors

$$I_{Mot\ mean} = \frac{\sum \frac{I_{Mot\ B} + I_{Mot\ E}}{2} \cdot \Delta t_i}{T}$$

$\frac{I_{Mot\ B} + I_{Mot\ E}}{2}$ Mean motor current in time segment $\Delta t_i$ (B: initial value, E: final value)

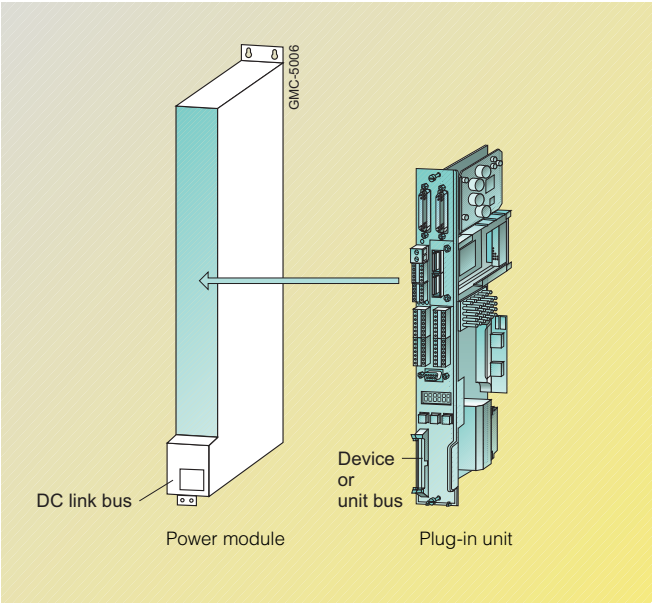


Fig. 6/6
Drive module

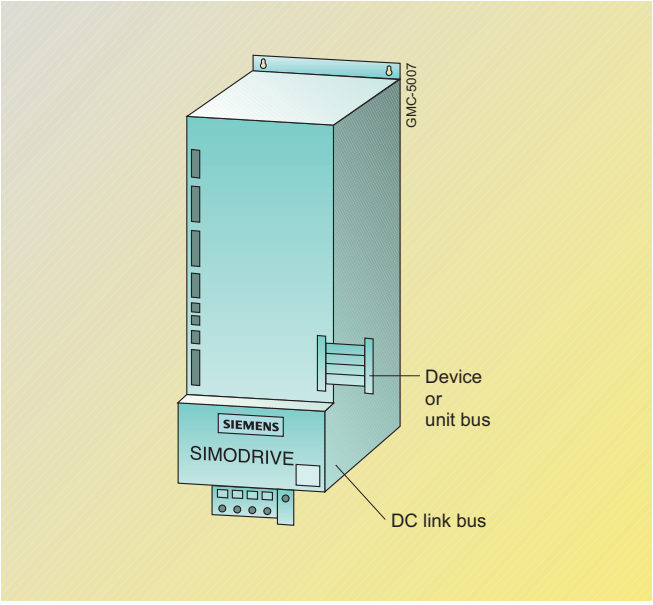


Fig. 6/7
Infeed module

### 7. Selection of the infeed module

The infeed module must always be located on the left as the first module. Power modules must be located next to the infeed module in descending order of rated current from left to right (highest rating on left, lowest on right). Infeed modules can only be used separately from each other, i.e. two infeed modules cannot be connected together.

## Calculating the DC link power for the infeed module

### *Motor characteristic for O/I (aka. U/E)[1]) and I/RF (aka. I/R)[2]) infeed modules, 400 V AC/480 V AC*

The rated data for induction motors depends on the rated motor voltage. The infeed module needs to provide the motor voltage, which corresponds to the motor data.

For the 1P. series Siemens High Performance motors please use the correct data tables in the General Motion Control Catalog Part 2 for your combination of supply voltages and infeed module as outlined below.

| Line supply voltage | 400 V AC | 480 V AC |
|---|---|---|
| Use motor under the category | MC 400 V AC | MC 480 V AC |

For any other motor type be aware that the maximum output voltage to the motor varies dependent on the combination of infeed module and supply voltage. The following table states the maximum output voltage to the motor.

| Line supply voltage | 400 V AC | 480 V AC |
|---|---|---|
| O/I[1]) | 350 V AC | 415 V AC |
| I/RF[2]) | 385 V AC | 415 V AC |

### *Infeed module: Selection and size optimization*

When multi-axis drives are used, several power modules are supplied with power by an infeed module. When the infeed module is being selected it must be determined whether it is able to supply enough peak and continuous power to the power module during a regular load cycle. The criteria are as follows:

- The maximum DC link power must be less than the maximum permissible output power (see chapter 3) of the infeed module. In the worst case, provided that the maximum power of each drive module occurs simultaneously, the infeed module must be sized as follows:

$$P_{\text{Infeed max}} > \sum P_{\text{DC link pos max.}}$$

$P_{\text{DC link pos max.}}$ = maximum motoring DC link power

If this is not the case then the infeed module can be selected by determining the maximum power of all axes combined. This takes into consideration that the maximum power requirement of each axis does not occur simultaneously. Refer to calculating example in this chapter for more details.

The positive (motoring) DC link power for each power module is calculated as follows:

$$P_{\text{DC link pos}} = \frac{P_{\text{Mot pos}}}{\eta_{\text{power module}} \cdot \eta_{\text{Mot}}}$$

The motor power is calculated according to the following equation:

$$P_{\text{Mot}}[\text{kW}] = \frac{\tau_{\text{Mot}}[\text{Nm}] \cdot n_{\text{Mot}}[\text{rpm}]}{9550}$$

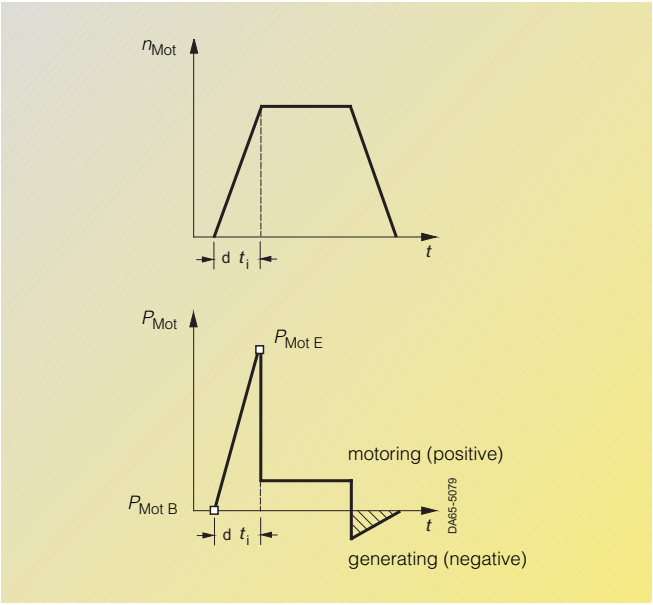


Fig. 6/8
Example of motor speed and motor output in a time segment $\Delta t_i$

- After selecting an infeed module which is able to satisfy the maximum supply power demand of the drive axis it must be checked whether the rated power of the infeed module is sufficient as well. For one or more axes the rated power of the infeed module must fulfill the following condition.

$$P_{\text{n pos infeed module}} > \frac{\sum\left(\frac{P_{\text{Mot pos RMS}}}{\eta_{\text{power module}} \cdot \eta_{\text{Mot}}}\right)}{X}$$

$X = 1.03$ for $T \leq 10$ s
$X = 0.90$ for 10 s $< T \leq 1$ min
$X = 0.89$ for 1 min $< T \leq 10$ min

$T$ = Total cycle time

$$P_{\text{Mot RMS}} > \sqrt{\frac{\sum\left(\frac{P_{\text{Mot B}} + P_{\text{Mot E}}}{2}\right)^2 \cdot \Delta t_i}{T}}$$

$P_{\text{Mot B}}$ = initial motor power in time increment $\Delta t_i$

$P_{\text{Mot E}}$ = final motor power in time increment $\Delta t_i$

For O/I[1]) infeed modules only positive motor power has to be evaluated to determine the correctly sized infeed module.

For I/RF)[2]) infeed modules both positive (motoring) and negative (regenerating) power values must be separately evaluated.

The energy fed back to the DC link must not exceed the continuous and peak load capability of the I/RF[2]) infeed module. To determine the DC link peak and continuous power during regeneration (braking) the equations below are to be used.

$$P_{\text{DC link regen}} = P_{\text{Mot neg}} \cdot \eta_{\text{power module}} \cdot \eta_{\text{mot}}$$

$$P_{\text{n infeed module}} > \frac{\sum\left(P_{\text{Mot neg RMS}} \cdot \eta_{\text{Power module}} \cdot \eta_{\text{Mot}}\right)}{X}$$

$P_{\text{Mot neg}}$ = max. power during braking

1) Unregulated/non regenerative unit.

2) Regulated/regenerative unit.

## Checking the 24 V DC power supply rating and braking calculations

In addition to the DC link power requirement, it is also necessary to check the 24 V DC power supply rating of the infeed module in order to determine whether or not a monitoring module (supplemental 24 V DC supply) is needed.

The required power supply rating depends on the:

- Size of the infeed/regenerative feedback modules.
- Size of the drive modules.
- Number of modules

The infeed or monitoring module offers a basic power supply rating for the electronics points (EP) and gating points (AP).

The power supply requirement of a drive grouping is calculated by summing all of the electronic points (EP) and gating points (AP) of a drive system. These values can be found in table 1, page 6/9.

If one of these values is exceeded, an (additional) monitoring module must be provided.

The monitoring module must be mounted on the left upstream of the modules to be monitored.

- DC link capacitance

  Every infeed module has a maximum value which restricts expansion of the DC link capacitors. It must be ensured that the DC link capacitance in the selected drive group is not exceeded. Therefore all of the DC link capacitance of the various units in a drive system must be summed and compared to the avaliable charging limit of the infeed module. The DC link capacitance of all available module and accessories, including the charging limit of the infeed modules, can be found in table 1, page 6/9.

  To check the 24 V DC power supply rating use table 2, page 6/11. The frequency of precharging the DC link by the infeed module is given by the following formula:

$$\text{No. of charging operations in 8 min} = \frac{\text{Charging limit infeed module } [\mu F]}{\Sigma \text{ DC link capacitance of configured drive grouping } [\mu F]}$$

Only one infeed/regenerative feedback module or one openloop infeed module is permitted per SIMODRIVE 611u system configuration.

### 8. Selection of braking unit and braking resistor

For the O/I non regenerative infeed modules the braking chopper is included along with the resistor for the 5 kW and 10 kW ratings. The available ratings for the pulsed resistors of the O/I non regenerative infeed modules are as follows:

- Infeed module 5 kW (w/internal resistor)[1])

  200 W continuous rating

  10 kW short-time rating for 120 ms once per 10 s cycle without previous load.

- Infeed module 10 kW (w/internal resistor)[1])

  300 W continuous rating

  25 kW short-time rating for 120 ms once per 10 s cycle without previous load.

- Infeed module 28 kW (external resistor needed)

  max. 2 x 300 W continuous rating

  max. 2 x 25 kW short-time rating for 120 ms once per 10 s cycle without previous load

  max. 2 x 1.5 kW continuous rating

  max. 2 x 25 kW short-time rating for 12 ms once per 10 s cycle without previous load

  For the 28 kW O/I, the pulsed resistors must be ordered separately and installed externally.

With greater energy feedback values, a separate pulsed resistor module must be provided or the feedback power must be reduced by prolonging the braking times.

Subject to certain conditions, several pulsed resistor modules can be connected in parallel.

The maximum number of pulsed resistor modules depends on the DC link capacitance of the drive configuration in question. One pulsed resistor module can be installed for every full 500 $\mu$F of DC link regenerative capacitance.

Only the DC link capacitance of the coupled power modules or special modules need to be taken into consideration for those O/I modules that already contain a pulsed resistor unit. If the pulsed resistor unit can be switched off, the internal DC capacitance can be included in determining the dimensions of the pulsed resistor module.

As regards the braking operation of the motors, check that the energy fed back to the DC link does not exceed the permissible peak load capability of the feedback converter.

- Braking resistor selection

  The selection of the braking resistor for one or more axes depends on the following criteria:

- $P_{\text{max br resistor}} \geq \sum (P_{\text{Mot br max}} \cdot \eta_{\text{Mot}} \cdot \eta_{\text{power module}})$
- $E_{\text{br max}} \geq \frac{1}{2} \cdot \sum (P_{\text{Mot br max}} \cdot t_{\text{br}})$
- $P_{\text{n resistor}} \geq \sum (P_{\text{Mot br mean}} \cdot \eta_{\text{Mot}} \cdot \eta_{\text{power module}})$

$$P_{\text{Mot br mean}} = \frac{\sum \frac{P_{\text{Mot br B}} + P_{\text{Mot br E}}}{2} \cdot \Delta t_i}{T}$$

$E_{\text{br max}}$ Maximum braking energy [Ws]

$T$ Total cycle time

If several axes are braked simultaneously then the summation sign has to be used. In case that only one axis is operated at a time then only the highest value for the peak power, peak energy and continuous power have to be considered.

For regenerative infeed modules, it is possible to connect a pulsed resistor module and external braking resistor for emergency braking (i.e. in the event of a power failure).

### 9. Selection of other components

- Transformers

  It is possible to connect the drive converter directly to a grounded (TN) line supply network for 3-ph. 380 to 480 V AC. For other voltages or other supply networks a transformer is required.

- Commutating reactors

  HF commutating reactors are required for all infeed modules with the exception of the 5 kW and 10 kW O/I (aka. U/E) non regenerative units. The following table can be used as a guide for selecting the proper HF commutating reactor.

- RFI components (mains filters)

  The mains filters are assigned to the mains infeed modules and limit the line-related emitted interference from the drive system. Together with the HF commutating reactor, the mains filter should also be installed near the mains infeed module, with the filter always on the mains side. Because the connecting cables are subject to high interference levels, these cables must be laid with shielding. We recommend using mains filter products listed in Section 3.

Operating voltage: 3-ph. 300 to 520 V AC/45 to 65 Hz

| Module | | HF commutating reactor | Order No. |
|---|---|---|---|
| O/I (aka. U/E)[2]) | 28/ 50 kW | 28 kW | 6SN11 11-1AA00-0CA0 |
| I/RF (aka. I/R)[3]) | 16/ 21 kW | 16 kW | 6SN11 11-0AA00-0BA1 |
| | 36/ 47 kW | 36 kW | 6SN11 11-0AA00-0CA1 |
| | 55/ 71 kW | 55 kW | 6SN11 11-0AA00-0DA1 |
| | 80/104 kW | 80 kW | 6SN11 11-0AA00-0EA1 |
| | 120/156 kW | 120 kW | 6SN11 11-0AA00-0FA0 |

The HF commutating reactor should be installed as near as possible to the mains infeed module.

1) External resistor connection is not possible. 2) Unregulated/non regenerative unit. 3) Regulated/regenerative unit.

## Additional components

- Mains filter package

  The mains filter and the HF commutating reactors are combined as a logistics unit in the form of mains filter packages.

- Overvoltage limiter module (surge arrestor)

  The overvoltage limiter module limits the overvoltages that occur as the result of, for example, switching operations on inductive consumers and on network matching transformers to values acceptable for the mains infeed modules above 10 kW.

  The overvoltage limiter module is used for upstream transformers or networks that do not meet IEC requirements.

  **For UL compliance of the mains infeed module the overvoltage limiter module must be used.**

  An appropriate protective circuit is integrated as standard in the 5 kW O/I module.

- Built-on fan

  A built-on fan (6SN11 62-0BA02-0AA1) is required for the 80 kW and 120 kW infeed modules.

- Shield terminal plates

  Add-on shield terminal plates are available for the infeed and power modules. The plates also accommodate mounting points for terminals for the brake connection.

- Option modules

  An optional communication module is available to communicate via PROFIBUS-DP. This module also allows for the motion control with PROFIBUS-DP-functions.

  An optional terminal extension board is available to expand the I/O capability of the plug-in-unit axis A only.

- 2-tier configuration

  If space is limited, the SIMODRIVE 611 converter system modules can also be arranged on top of each other in two tiers.

  The distance between the tiers must be not less than 7.88 in (200 mm). The location of the unit bus cable determines the maximum distance.

  The modules with higher ratings and the infeed module must be located in the upper tier.

  A connecting cable for the unit bus is required for two-tier configurations of the SIMODRIVE 611 converter system.

  The DC link connection in two-tier configurations must be made with parallel cables (max. length 5 m (16 ft 5 in)). In the case of series-connected modules of 11.82 in (300 mm) width, the conductor cross-section must be Cu 70 $mm^2$/ AWG 2/0 and for smaller modules it must be Cu 50 $mm^2$/ AWG 1/0. The cable must be laid short-circuit-proof and earth-fault-proof. A bonding conductor of the same cross-section must also be laid and connected to the housings of both interconnected modules.

  The maximum configuration of a drive grouping is limited by the capacity of the infeed module. Only one unit bus extension is permissible: either to the left, e.g. for a second tier; or to the right, e.g. to bypass a cubicle panel.

  The unit bus line of a drive grouping to an infeed or monitoring module must not be longer than 6 ft 11 in (2.1 m) (from the infeed point). Two device bus junctions each a maximum length of 6 ft 11 in (2.1 m) from the junction point are possible at the infeed for the 2-tier configuration.

  For 2-tier configurations, adapter terminals for the DC link are required along with a unit (device) bus extension cable.

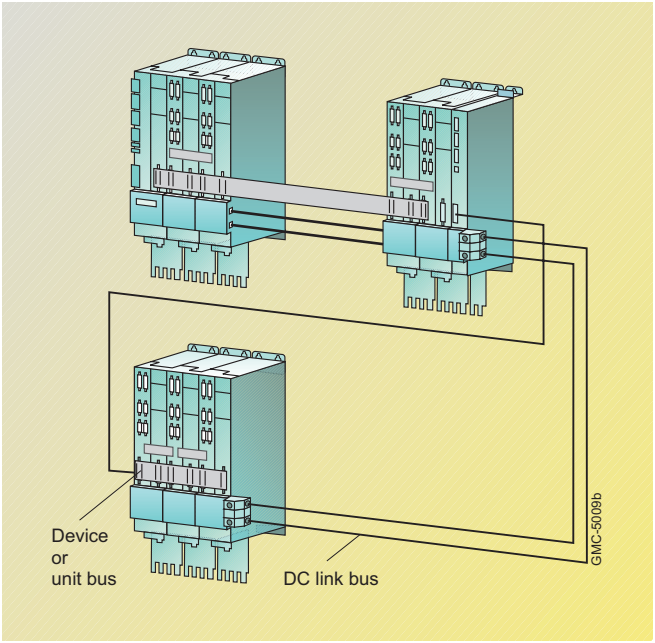


Fig. 6/9
2-tier configuration

- Cabling

  The cable cross-section of the DC link connection depends on the actual configuration of the SIMODRIVE 611 converter system and must be dimensioned according to EN 60 204.

  All power cables, including the mains lead, the connection between the I/RF module, the HF commutating reactor and mains filter, and the motor leads must be laid with shielding and make contact over a large area.

  The mounting surfaces for the mains infeed modules and drive modules and the commutating reactors and mains filters must be installed on mounting plates with low-resistance conducting surface (e.g. galvanized bearing plates).

## Table 1, Assessment factors

| Module | EP and AP for the 24 V DC power supply rating | | | | | | DC link | Capacitance | |
|---|---|---|---|---|---|---|---|---|---|
| | Provides | Requires | Provides | Requires | Provides | Requires | Limit | DC link | Braking utilization |
| **SIMODRIVE power modules with the following plug-in-units** | | | | | | | | | |
| | 1-axis resolver<br>**6SN11 18-□NJ00-0AA1** | | 2-axis resolver<br>**6SN11 18-□NK00-0AA1** | | 2-axis sin/cos<br>1 $V_{PP}$/absolute encoder<br>**6SN11 18-□NH00-0AA1** | | | | |
| | **0**: Speed/torque setpoint, **1**: Speed/torque setpoint positioning | | | | | | | | |
| **1-axis version** | | | | | | | | | |
| **6SN11 2□-1AA00-0HA1** | 0<br>0 | EP 1.1<br>AP 1.7 | 0<br>0 | EP 1.4<br>AP 2.0 | 0<br>0 | EP 1.5<br>AP 2.0 | 0<br>0 | 75 | 75 |
| **6SN11 2□-1AA00-0AA1** | 0<br>0 | EP 1.1<br>AP 1.7 | 0<br>0 | EP 1.4<br>AP 2.0 | 0<br>0 | EP 1.5<br>AP 2.0 | 0<br>0 | 75 | 75 |
| **6SN11 2□-1AA00-0BA1** | 0<br>0 | EP 1.1<br>AP 1.7 | 0<br>0 | EP 1.4<br>AP 2.0 | 0<br>0 | EP 1.6<br>AP 2.0 | 0<br>0 | 110 | 110 |
| **6SN11 2□-1AA00-0CA1** | 0<br>0 | EP 1.1<br>AP 1.7 | 0<br>0 | EP 1.4<br>AP 2.0 | 0<br>0 | EP 1.6<br>AP 2.0 | 0<br>0 | 330 | 330 |
| **6SN11 2□-1AA00-0DA1** | 0<br>0 | EP 1.2<br>AP 1.7 | 0<br>0 | EP 1.4<br>AP 2.0 | 0<br>0 | EP 1.7<br>AP 2.0 | 0<br>0 | 495 | 495 |
| **6SN11 2□-1AA00-0LA1** | 0<br>0 | EP 1.7<br>AP 1.8 | 0<br>0 | EP 1.7<br>AP 2.1 | 0<br>0 | EP 1.7<br>AP 2.1 | 0<br>0 | 495 | 495 |
| **6SN11 2□-1AA00-0EA1** | 0<br>0 | EP 2.7<br>AP 1.8 | 0<br>0 | EP 2.7<br>AP 2.1 | 0<br>0 | EP 2.7<br>AP 2.1 | 0<br>0 | 990 | 990 |
| **6SN11 2□-1AA01-0FA1** | 0<br>0 | EP 2.7<br>AP 1.9 | 0<br>0 | EP 2.7<br>AP 2.1 | 0<br>0 | EP 2.7<br>AP 2.1 | 0<br>0 | 2145 | 2145 |
| **6SN11 2□-1AA00-0JA1** ① | 0<br>0 | EP 1.3<br>AP 1.9 | 0<br>0 | EP 1.5<br>AP 2.1 | 0<br>0 | EP 1.7<br>AP 2.1 | 0<br>0 | 2145 | 2145 |
| **6SN11 2□-1AA00-0KA1** ① | 0<br>0 | EP 1.4<br>AP 1.9 | 0<br>0 | EP 1.6<br>AP 2.1 | 0<br>0 | EP 1.8<br>AP 2.1 | 0<br>0 | 4290 | 4290 |
| **6SN11 23-1AA02-0FA1** ① | | EP 1.3<br>AP 1.9 | 0<br>0 | EP 1.5<br>AP 2.1 | 0<br>0 | EP 1.7<br>AP 2.1 | 0<br>0 | 2145 | 2145 |
| **2-axis version** | | | | | | | | | |
| **6SN11 2□-1AB00-0HA1** | 0<br>0 | EP 1.3<br>AP 2.1 | 0<br>0 | EP 1.5<br>AP 2.4 | 0<br>0 | EP 1.6<br>AP 2.4 | 0<br>0 | 150 | 150 |
| **6SN11 2□-1AB00-0AA1** | 0<br>0 | EP 1.4<br>AP 2.1 | 0<br>0 | EP 1.7<br>AP 2.4 | 0<br>0 | EP 1.7<br>AP 2.4 | 0<br>0 | 150 | 150 |
| **6SN11 2□-1AB00-0BA1** | 0<br>0 | EP 1.6<br>AP 2.1 | 0<br>0 | EP 1.8<br>AP 2.4 | 0<br>0 | EP 1.8<br>AP 2.4 | 0<br>0 | 220 | 220 |
| **6SN11 2□-1AB00-0CA1** | 0<br>0 | EP 1.7<br>AP 2.1 | 0<br>0 | EP 1.8<br>AP 2.4 | 0<br>0 | EP 1.8<br>AP 2.4 | 0<br>0 | 660 | 660 |
| | **3**: internal cooling, **4**: external cooling | | | | ① With built-on fan for hose cooling | | | | |
| **SIMODRIVE infeed modules** | | | | | | | | | |
| **O/I[1]) 5 kW/10 kW**<br>**6SN11 4□-1AB00-0BA1** | EP 3.5<br>AP 7 | EP 0.3<br>AP – | EP 3.5<br>AP 7 | EP 0.3<br>AP – | EP 3.5<br>AP 7 | EP 0.3<br>AP – | 1200 | 150 | 0 |
| **10 kW/25 kW**<br>**6SN11 4□-1AA01-0AA1** | EP 8<br>AP 17 | EP 0.5<br>AP 0.5 | EP 8<br>AP 17 | EP 0.5<br>AP 0.5 | EP 8<br>AP 17 | EP 0.5<br>AP 0.5 | 6000 | 440 | 0 |
| **28 kW/50 kW**<br>**6SN11 4□-1AA00-0CA0** | EP 8<br>AP 17 | EP 0.5<br>AP 0.5 | EP 8<br>AP 17 | EP 0.5<br>AP 0.5 | EP 8<br>AP 17 | EP 0.5<br>AP 0.5 | 20000 | 990 | 0 |
| **I/RF[2]) 16 kW/21 kW**<br>**6SN11 4□-1BA01-0BA1** | EP 8<br>AP 17 | EP 0.5<br>AP 0.5 | EP 8<br>AP 17 | EP 0.5<br>AP 0.5 | EP 8<br>AP 17 | EP 0.5<br>AP 0.5 | 6000 | 495 | 0 |
| **36 kW/47 kW**<br>**6SN11 4□-1BA02-0CA1** | EP 8<br>AP 17 | EP 0.5<br>AP 0.5 | EP 8<br>AP 17 | EP 0.5<br>AP 0.5 | EP 8<br>AP 17 | EP 0.5<br>AP 0.5 | 20000 | 990 | 0 |
| **55 kW/71 kW**<br>**6SN11 4□-1BA01-0DA1** | EP 8<br>AP 17 | EP 0.5<br>AP 0.5 | EP 8<br>AP 17 | EP 0.5<br>AP 0.5 | EP 8<br>AP 17 | EP 0.5<br>AP 0.5 | 20000 | 2145 | 0 |
| **80 kW/131 kW**<br>**6SN11 4□-1BB00-0EA1** | EP 8<br>AP 17 | EP 1<br>AP 0.75 | EP 8<br>AP 17 | EP 1<br>AP 0.75 | EP 8<br>AP 17 | EP 1<br>AP 0.75 | 20000 | 2145 | 0 |
| **120 kW/175 kW**<br>**6SN11 4□-1BB00-0FA1** | EP 8<br>AP 17 | EP 1<br>AP 0.75 | EP 8<br>AP 17 | EP 1<br>AP 0.75 | EP 8<br>AP 17 | EP 1<br>AP 0.75 | 20000 | 4290 | 0 |
| **Monitoring module**<br>**6SN11 12-1AC01-0AA1** | EP 8<br>AP 17 | EP 0<br>AP 0 | EP 8<br>AP 17 | EP 0<br>AP 0 | EP 8<br>AP 17 | EP 0<br>AP 0 | 0<br>0 | 1000 | 75 |
| **Pulsed resistor module**<br>**6SN11 13-1AB01-0BA1** | 0<br>0 | EP 0.2<br>AP 0.1 | 0<br>0 | EP 0.2<br>AP 0.1 | 0<br>0 | EP 0.2<br>AP 0.1 | 0<br>0 | 75 | 75 |
| | **5** or **6,** see chapter 3 | | | | | | | | |

Assessment factors of single modules for electronics points (EP) and gating points (AP) as well as permissible combinations of power modules and closed-loop control plug-in units.

The details for the EP and AP assessment factors refer to the approved encoder cable lengths.

- PROFIBUS-DP
  An additional 0.6 EP (electronics points) must be taken into consideration in the electronic area when the option is used.
- Terminal module
  No additional electronics points have to be taken into consideration in this case.

1) O/I (aka. U/E), unregulated/ non regenerative unit.

2) I/RF (aka. I/R), regulated/ regenerative unit.

Actual physical configuration of drive system from left to right

Resultant = Previous Resultant + Provides – Requires

| Module type | Electronic points | | | Gating points | | | DC link capacity | | |
|---|---|---|---|---|---|---|---|---|---|
| | Provides | Requires | Resultant | Provides | Requires | Resultant | Capacity limit of infeed module ($\mu$F) | DC link capacity utilization ($\mu$F) | Braking utilization ($\mu$F) |
| I/R Infeed Module 6SN11 45-1BB00-0FA1 | 8 | 1 | 0 + 8 – 1 = 7 | 17 | 0.75 | 16.25 | 20000 | 4290 | 0 |
| 1-Axis Drive Module 6SN11 23-1AA00-0EA1 | 0 | 2.7 | 7 + 0 – 2.7 = 4.3 | 0 | 2.1 | 14.15 | | 990 | 990 |
| 1-Axis Drive Module 6SN11 23-1AA00-0EA1 | 0 | 2.7 | 1.6 | 0 | 2.1 | 12.05 | | 990 | 990 |
| **1-Axis Drive Module 6SN11 23-1AA00-0EA1** | 0 | 2.7 | –1.1 | 0 | 2.1 | 9.95 | | 990 | 990 |
| | **Note: Since the value of the resultant went negative, a monotoring module is required and must be physically located in this position. The current drive module and all subsequent modules must now be physically located to the right of the monitoring module.** | | | | | | | | |
| | | | | | | | | | must move to this position |
| | **Note: When a monitoring module is used the resultant calculation is now continued with the value provided by the monitoring module. Any remaining resultant from above is ignored.** | | | | | | | | |
| Monotoring Module 6SN11 12-1AC01-0AA1 | 8 | 0 | 8 | 17 | 0 | 17 | | 1000 | 75 |
| 1-Axis Drive Module 6SN11 23-1AA00-0EA1 | 0 | 2.7 | 5.3 | 0 | 2.1 | 14.9 | | 990 | 990 |
| 1-Axis Drive Module 6SN11 23-1AA00-0EA1 | 0 | 2.7 | 2.6 | 0 | 2.1 | 12.8 | | 990 | 990 |
| Pulsed Res. Module 6SN 11 13-1AB01-0BA1 | 0 | 0.2 | 2.4 | 0 | 0.1 | 12.7 | | 75 | 75 |
| Pulsed Res. Module 6SN11 13-1AB01-0BA1 | 0 | 0.2 | 2.2 | 0 | 0.1 | 12.6 | | 75 | 75 |
| | Resultant electronic points[1] (must be > 0) | | 2.2 | Resultant gating points[1] (must be > 0) | | 12.6 | Σ DC link utilization < limit of infeed module | 9400 | |
| | | | | | | | Σ braking utilization[2] | | 4185 |

Left

Right

2.2 > 0
Therefore: o.k.

12.6 > 0
Therefore: o.k.

9400 < 20,000
Therefore: o.k.

so: $\frac{4185}{500} = 8.37$
Therefore: max. of 4 Braking Resistors

**All of the required data values are found in Table 1!**

1) If resultant goes negative during calculation, a Monitoring module must be added. Start with the 8 electronic points and 17 gating points provided by the monitoring module.

2) Max. number of permissible braking resistors is equal to the integer value of Σ braking utilization/500 $\mu$F: Example 1) 1200 $\mu$F/500 $\mu$F = 2.4 = > max. 2
2) 1900 $\mu$F/500 $\mu$F = 3.8 = > max. 3

**Table 2, Assessment and configuration sheet**

| **Module type** | Electronic points | | | Gating points | | | DC link capacity | | |
|---|---|---|---|---|---|---|---|---|---|
| | Provides | Requires | Resultant | Provides | Requires | Resultant | Capacity limit of infeed module ($\mu$F) | DC link capacity utilization ($\mu$F) | Braking utilization ($\mu$F) |
| | | | | | | | | | |
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| | | | | | | | | | |
| | Resultant electronic points[1]) (must be > 0) | | | Resultant gating points[1]) (must be > 0) | | | $\Sigma$ DC link utilization < limit of infeed module | | |
| | | | | | | | $\Sigma$ braking utilization[2]) | | |

**All of the required data values are found in Table 1!**

1) If resultant goes negative during calculation, a Monitoring module must be added. Start with the 8 electronic points and 17 gating points provided by the monitoring module.

2) Max. number of permissible braking resistors is equal to the integer value of $\Sigma$ braking utilization/500 $\mu$F: Example 1) 1200 $\mu$F/500 $\mu$F = 2.4 = > max. 2
2) 1900 $\mu$F/500 $\mu$F = 3.8 = > max. 3

## Calculating example

A three-axis conveyor vehicle is to be designed. The x-axis is the main propelling drive, the y-axis is the fork drive and the z-axis is the lifting drive. The propelling drive and the lifting drive can be operated simultaneously whereas the fork drive only operates alone. The x-axis and the y-axis are driven via toothed belts. The z-axis is driven via a gear rack. Three inverters are to be used on one rectifier unit.
Positioning is to be carried out non-centrally in the inverter. Profibus is to be used for connection to a PLC.

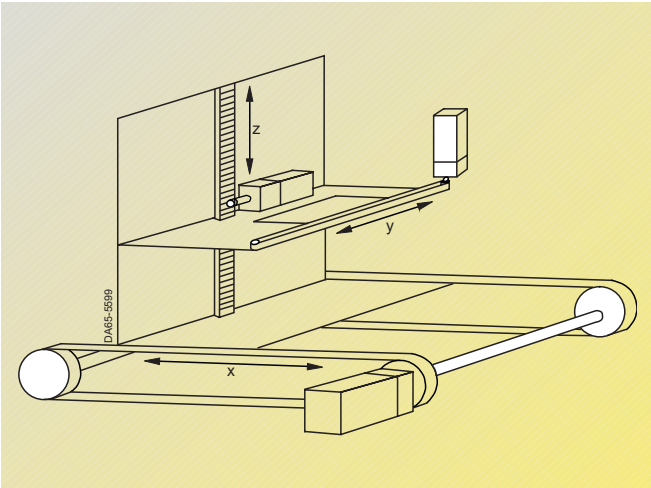



Fig. 6/9
Line drawing of a three-axis conveyor vehicle

## Calculation of the x-axis as the travel gear

### 1. Data of the drive

- Mass to be transported $m = 400$ kg
- Diameter of drive wheel $D = 0.14$ m
- Max. speed $v_{max} = 1.6$ m/s
- Max. acceleration and deceleration $a_{max} = 6.4$ m/s$^2$
- Distance travelled $s = 2$ m
- Cycle time $T = 7$ s
- Mech. efficiency $\eta_{mech} = 0.9$
- Specific travelling resistance $w_f = 0.1$
- Mech. accuracy $\Delta s_{mech} = \pm 0.1$ mm
- Overall accuracy required $\Delta s_{tot} = \pm 0.2$ mm

### 2. Travel curve

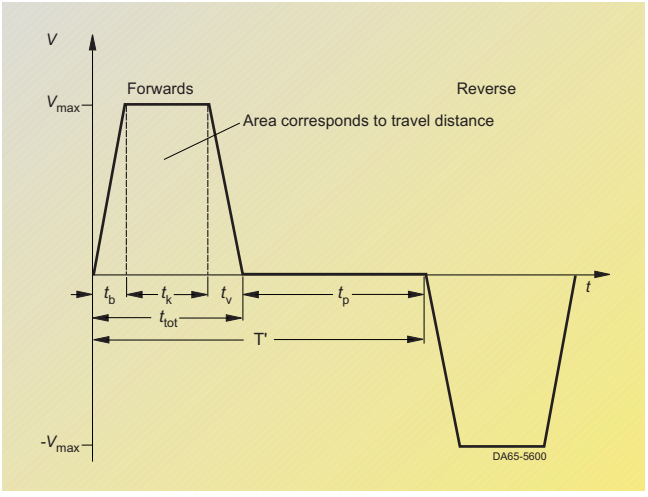



Fig. 6/10
Travel curve for forwards and reverse travel

It is sufficient to only consider forwards travel because the conditions are the same for forwards and reverse travel.

- The new cycle time is therefore:

$$T' = \frac{T}{2}$$

- For the remaining values of the travel curve, the following is obtained:

$$t_b = t_v = \frac{v_{max}}{a_{max}} = \frac{1.6}{6.4} = 0.25 \text{ s}$$

$$t_k = \frac{s - v_{max} \cdot \frac{t_b}{2} - v_{max} \cdot \frac{t_v}{2}}{v_{max}} = \frac{2 - 1.6 \cdot \frac{0.25}{2} - 1.6 \cdot \frac{0.25}{2}}{1.6} = 1 \text{ s}$$

$$t_{tot} = t_b + t_k + t_v = 0.25 + 1 + 0.25 = 1.5 \text{ s}$$

$$t_p = T' - t_{tot} = 3.5 - 1.5 = 2 \text{ s}$$

### 3. Max. speed under load, max. load torque, selection of the gear unit

- Max. speed under load at the drive wheel

$$n_{\text{Load max}} = \frac{v_{\max} \cdot 60}{\pi \cdot D} = \frac{1.6 \cdot 60}{\pi \cdot 0.14} = 218.27 \text{ rpm}$$

A gear transmission ratio of $i = 10$ is selected here.
A synchronous servomotor can thus be used with a rated speed of 3000 rpm.

$$n_{\text{Mot max}} = i \cdot n_{\text{Load max}} = 10 \cdot 218.27 = 2182.7 \text{ rpm}$$

- Resistance torque

$$\tau_W = m \cdot g \cdot w_f \cdot \frac{D}{2} = 400 \cdot 9.81 \cdot 0.1 \cdot \frac{0.14}{2} = 27.47 \text{ Nm}$$

- Acceleration and deceleration torque for the load

$$\alpha_{\text{load}} = \alpha_{\max} \cdot \frac{2}{D} = 6.4 \cdot \frac{2}{0.14} = 91.4 \text{ s}^{-2}$$

$$J_{\text{load}} = m \cdot \left(\frac{D}{2}\right)^2 = 400 \cdot \left(\frac{0.14}{2}\right)^2 = 1.96 \text{ kgm}^2$$

$$\tau_{\text{a, br load}} = J_{\text{load}} \cdot \alpha_{\text{load}} = 1.96 \cdot 91.4 = 179.2 \text{ Nm}$$

- Max. torque on the output side of the gear unit

$$\tau_{\text{load max}} = (\tau_{\text{a load}} + \tau_W) \cdot \frac{1}{\eta_{\text{mech}}} = (179.2 + 27.47) \cdot \frac{1}{0.9} = 229.6 \text{ Nm}$$

A planetary gear unit for mounting on 1FT6 motors is therefore used where

$\tau_{\max} = 400$ Nm at $i = 10$

$J^*_G = 0.001$ kgm$^2$ moment of inertia referred to motor
$\eta_G = 0.95$ gear unit efficiency
$\alpha_G = 3'$ torsional play

- Acceleration and deceleration torque for the gear unit

$$\tau_{\text{a, br G}} = J^*_G \cdot \alpha_{\text{load}} \cdot i = 0.001 \cdot 91.4 \cdot 10 = 0.914 \text{ Nm}$$

- Positioning accuracy

$$\Delta S_{\text{gear}} = \frac{D \cdot \pi}{360°} \cdot \frac{\alpha_G}{60} = \frac{0.14 \cdot \pi}{360} \cdot \frac{3}{60} = 0.061 \text{ mm}$$

i.e. ±0.0305 mm

$$\Delta S_{\text{encoder}} = \frac{D \cdot \pi}{i \cdot z} = \frac{0.14 \cdot \pi}{10 \cdot 1024} = \pm 0.04 \text{ mm}$$

with a 2-pole resolver**

$\Delta S_{\text{tot}} = \Delta S_{\text{mech}} + \Delta S_{\text{gear}} + \Delta S_{\text{encoder}} =$
$0.1 + 0.0305 + 0.04 = 0.1705 < 0.2$ mm

The required accuracy is thus complied with.

### 4. Selection of the motor

Selection with regard to the dynamic limit curve

- The maximum motor torque occurs here because the deceleration is equal to the acceleration.

$$\tau_{\text{Mot max}} = \tau_{\text{a Mot}} + \tau_{\text{a br G}} + (\tau_{\text{a load}} + \tau_W) \cdot \frac{1}{i \cdot \eta_{\text{mech}} \cdot \eta_G}$$

$$= \tau_{\text{a Mot}} + 0.914 + (179.2 + 27.47) \cdot \frac{1}{10 \cdot 0.9 \cdot 0.95}$$

$$= \tau_{\text{a Mot}} + 25.08 \text{ Nm}$$

where $\tau_{\text{a Mot}} = J_{\text{Mot}} \cdot \alpha_{\text{load}} \cdot i = J_{\text{Mot}} \cdot 91.4 \cdot 10 = J_{\text{Mot}} \cdot 914 \text{ s}^{-2}$

The first 1FT6 motor with $n_n = 3000$ rpm, which satisfies the condition of the dynamic limit curve, is the 1FT6084–8AF7 with $P_n = 4.6$ kW, $\tau_n = 14.7$ Nm, $\tau_{\text{max perm}} = 65$ Nm, $J_{\text{Mot}} = 0.0065$ kgm$^2$ (with brake), $k_{Tn}100 = 1.34$ Nm/A, $\eta_{\text{Mot}} = 0.92$; $\tau_0 = 20$ Nm

- The acceleration and deceleration torque for the motor rotor is thus:

$$\tau_{\text{a, br Mot}} = 0.0065 \cdot 914 = 5.94 \text{ Nm}$$

- The maximum motor torque is equal to the motor torque during acceleration:

$$\tau_{\text{Mot max}} = \tau_{\text{Mot a}} = 5.94 + 25.08 = 31.03 \text{ Nm}$$

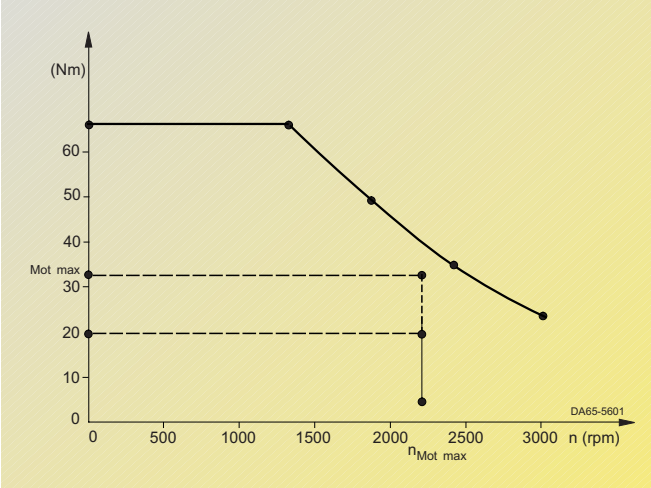
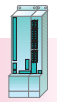



Fig. 6/11
Dynamic limit curve for the 1FT6084–8AF7 with the points of the load cycle

** Other approximate encoder accuracies
Sin/Cos Encoder (ERN 1387) ~ $10^5$ to $10^6$
Absolute value Encoder (EQN 1325) ~ $10^5$ to $10^6$.



## Calculating example

As a check on the thermal limits, the effective motor torque is calculated. This is done by determining all the motor torques within the travel curve in addition to the motor torque during acceleration.

- Motor torque during constant travel

$$\tau_{Mot\,k} = \tau_W \cdot \frac{1}{i \cdot \eta_{mech} \cdot \eta_G} = 27.47 \cdot \frac{1}{10 \cdot 0.9 \cdot 0.95} = 3.21\ \text{Nm}$$

- Motor torque during deceleration

$$\tau_{Mot\,br} = \tau_{br\,Mot} - \tau_{a\,G} + (-\tau_{br\,load} + \tau_W) \cdot \frac{1}{i \cdot (\eta_{mech} \cdot \eta_G)^{sign(-\tau_{br\,load} + \tau_W)}}$$

$$= -5.94 - 0.914 + (-179.2 + 27.47) \cdot \frac{0.9 \cdot 0.95}{10} = -19.83\ \text{Nm}$$

Here, the proportion of deceleration torque outweighs the resistance torque. Regenerative operation occurs. In this case, the efficiency levels are above the line (the sign before the bracketed term "$-\tau_{br\,load} + \tau_W$" is negative).

The torque characteristic can be determined using the values calculated for the motor torque.

- The effective motor torque is obtained from the torque characteristic as follows:

$$\tau_{eff} = \sqrt{\frac{\sum \tau^2_{Mot\,i} \cdot \Delta t_i}{T'}}$$

$$= \sqrt{\frac{31.03^2 \cdot 0.25 + 3.21^2 \cdot 1 + 19.83^2 \cdot 0.25}{3.5}} = 10\ \text{Nm}$$

- By using the travel curve, which is proportional to the speed, the mean motor speed is obtained:

$$n_{mean} = \frac{\sum \frac{|n_B + n_E|}{2} \cdot \Delta t_i}{T'}$$

$$= \frac{\frac{2182.7}{2} \cdot 0.25 + 2182.7 \cdot 1 + \frac{2182.7}{2} \cdot 0.25}{3.5} = 779.5\ \text{rpm}$$

The effective motor torque calculated at $n_{mean}$ is below the S1 curve. The motor is therefore suitable.

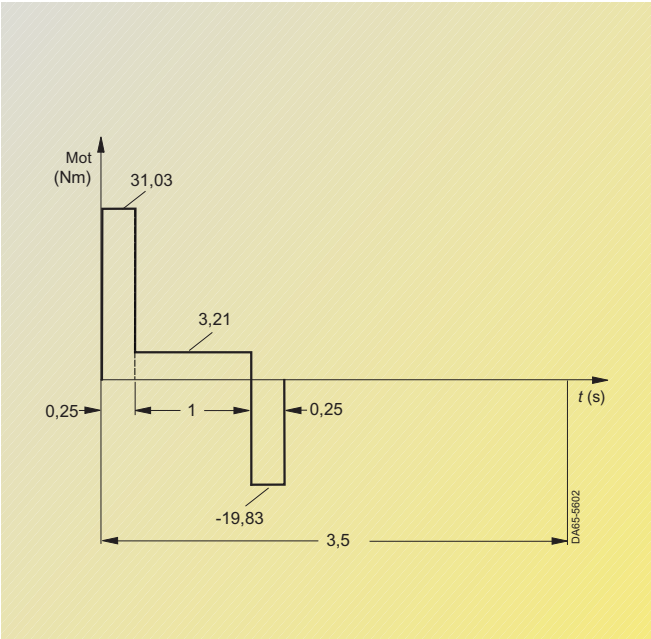



Fig. 6/12
Torque characteristic for forwards travel

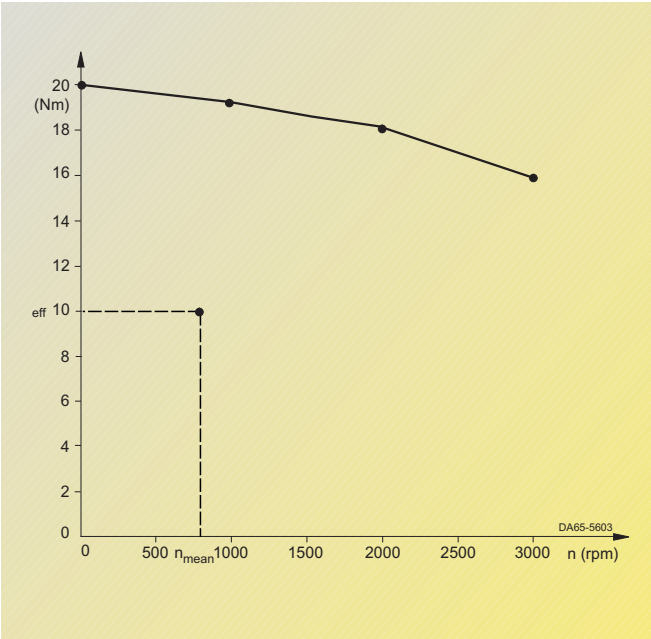



Fig. 6/13
S1 curve for the 1FT6084–8AF

## Calculating the y-axis as the travel gear

### 1. Data of the drive

- Mass to be transported — $m$ = 100 kg
- Diameter of drive wheel — $D$ = 0.1 m
- Max. speed — $v_{max}$ = 1 m/s
- Max. acceleration and deceleration — $a_{max}$ = 2.5 m/s$^2$
- Distance travelled — $s$ = 0.5 m
- Cycle time — $T$ = 7 s
- Mech. efficiency — $\eta_{mech}$ = 0.9
- Specific travelling resistance — $w_f$ = 0.1
- Mech. accuracy — $\Delta s_{mech}$ = ±0.1 mm
- Overall accuracy required — $\Delta s_{tot}$ = ±0.2 mm

### 2. Travel curve

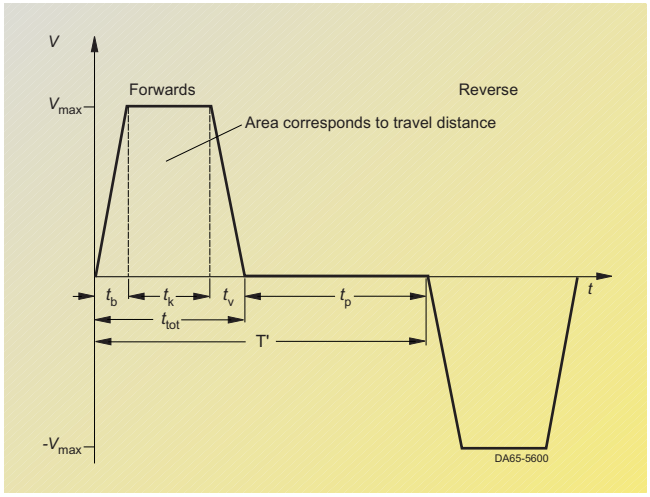



Fig. 6/14
Travel curve for forwards and reverse travel

It is sufficient to only consider forwards travel because the conditions are the same for forwards and reverse travel.

- The new cycle time is therefore:

$$T' = \frac{T}{2}$$

- For the remaining values of the travel curve, the following is obtained:

$$t_b = t_v = \frac{v_{max}}{a_{max}} = \frac{1.0}{2.5} = 0.4 \text{ s}$$

$$t_k = \frac{s - v_{max} \cdot \frac{t_b}{2} - v_{max} \cdot \frac{t_v}{2}}{v_{max}} = \frac{0.5 - 1.0 \cdot \frac{0.4}{2} - 1.0 \cdot \frac{0.4}{2}}{1.0} = 0.1 \text{ s}$$

$$t_{tot} = t_b + t_k + t_v = 0.4 + 0.1 + 0.4 = 0.9 \text{ s}$$

$$t_p = T' - t_{tot} = 3.5 - 0.9 = 2.6 \text{ s}$$

### 3. Max. speed under load, max. load torque, selection of the gear unit

- Max. speed under load at the drive wheel

$$n_{Load\ max} = \frac{v_{max} \cdot 60}{\pi \cdot D} = \frac{1.0 \cdot 60}{\pi \cdot 0.1} = 190.99 \text{ rpm}$$

A gear transmission ratio of $i$ =10 is selected here.
A synchronous servomotor can thus be used with a rated speed of 3000 rpm.

$$n_{Mot\ max} = i \cdot n_{Load\ max} = 10 \cdot 190.99 = 1909.99 \text{ rpm}$$

- Resistance torque

$$\tau_W = m \cdot g \cdot w_f \cdot \frac{D}{2} = 100 \cdot 9.81 \cdot 0.1 \cdot \frac{0.1}{2} = 4.91 \text{ Nm}$$

- Acceleration and deceleration torque for the load

$$\alpha_{load} = \alpha_{max} \cdot \frac{2}{D} = 2.5 \cdot \frac{2}{0.1} = 50.0 \text{ s}^{-2}$$

$$J_{load} = m \cdot \left(\frac{D}{2}\right)^2 = 100 \cdot \left(\frac{0.1}{2}\right)^2 = 0.25 \text{ kgm}^2$$

$$\tau_{a,\ br\ load} = J_{load} \cdot \alpha_{load} = 0.25 \cdot 50.0 = 12.5 \text{ Nm}$$

- Max. torque on the output side of the gear unit

$$\tau_{load\ max} = (\tau_{a\ load} + \tau_W) \cdot \frac{1}{\eta_{mech}} = (12.5 + 4.91) \cdot \frac{1}{0.9} = 19.3 \text{ Nm}$$

A planetary gear unit for mounting on 1FT6 motors is therefore used where

$\tau_{max}$ = 80 Nm at $i$ = 10

$J^*_G$ = 0.4 · 10$^{-4}$ kgm$^2$ moment of inertia referred to motor
$\eta_G$ = 0.95 gear unit efficiency
$\alpha_G$ = 3' torsional play

- Acceleration and deceleration torque for the gear unit

$$\tau_{a,\ br\ G} = J^*_G \cdot \alpha_{load} \cdot i = 0.4 \cdot 10^{-4} \cdot 50.0 \cdot 10 = 0.02 \text{ Nm}$$

- Positioning accuracy

$$\Delta S_{gear} = \frac{D \cdot \pi}{360°} \cdot \frac{\alpha_G}{60} = \frac{0.1 \cdot \pi}{360} \cdot \frac{3}{60} = 0.044 \text{ mm}$$

i.e. ±0.022 mm

$$\Delta S_{encoder} = \frac{D \cdot \pi}{i \cdot z} = \frac{0.1 \cdot \pi}{10 \cdot 1024} = \pm 0.03 \text{ mm}$$

with a 2-pole resolver**

$\Delta S_{tot} = \Delta S_{mech} + \Delta S_{gear} + \Delta S_{encoder}$
$= 0.1 + 0.044 + 0.03 = 0.174 < 0.2$ mm

The required accuracy is thus complied with.

## Calculating example

### 4. Selection of the motor

Selection with regard to the dynamic limit curve

- The maximum motor torque occurs here because the deceleration is equal to the acceleration.

$$\tau_{Mot\,max} = \tau_{a\,Mot} + \tau_{a\,br\,G} + (\tau_{a\,load} + \tau_W) \cdot \frac{1}{i \cdot \eta_{mech} \cdot \eta_G}$$

$$= \tau_{a\,Mot} + 0.02 + (12.5 + 4.91) \cdot \frac{1}{10 \cdot 0.9 \cdot 0.95}$$

$$= \tau_{a\,Mot} + 2.06\ \text{Nm}$$

where $\tau_{a\,Mot} = J_{Mot} \cdot \alpha_{load} \cdot i = J_{Mot} \cdot 50.0 \cdot 10 = J_{Mot} \cdot 500\ s^{-2}$

The first 1FT6 motor with $n_n$ = 3000 rpm, which satisfies the condition or the dynamic limit curve, is the 1FT6041-4AF7 with $P_n$ = 0.7 kW, $\tau_n$ = 2.2 Nm, $\tau_{max\,perm}$ = 10 Nm, $J_{Mot} = 0.39 \cdot 10^{-3}$ kgm$^2$ (with brake), $k_{Tn100}$ = 1.26 Nm/A, $\eta_{Mot}$ = 0.86; $\tau_0$ = 2.5 Nm

- The acceleration and deceleration torque for the motor rotor is thus:

$$\tau_{a,\,br\,Mot} = 0.39 \cdot 10^{-3} \cdot 500 = 0.20\ \text{Nm}$$

- The maximum motor torque is equal to the motor torque during acceleration:

$$\tau_{Mot\,max} = \tau_{Mot\,a} = 0.20 + 2.06 = 2.26\ \text{Nm}$$

As a check on the thermal limits, the effective motor torque is calculated. This is done by determining all the motor torques within the travel curve in addition to the motor torque during acceleration.

- Motor torque during constant travel

$$\tau_{Mot\,k} = \tau_W \cdot \frac{1}{i \cdot \eta_{mech} \cdot \eta_G} = 4.91 \cdot \frac{1}{10 \cdot 0.9 \cdot 0.95} = 0.57\ \text{Nm}$$

- Motor torque during deceleration

$$\tau_{Mot\,br} = -\tau_{br\,Mot} - \tau_{a\,G} + (-\tau_{br\,load} + \tau_W) \cdot \frac{1}{i \cdot (\eta_{mech} \cdot \eta_G)^{sign(-\tau_{br\,load} + \tau_W)}}$$

$$= -0.20 - 0.02 + (-12.5 + 4.91) \cdot \frac{0.9 \cdot 0.95}{10} = -0.87\ \text{Nm}$$

Here, the proportion of deceleration torque outweighs the resistance torque. Regenerative operation occurs. In this case, the efficiency levels are above the line (the sign before the bracketed term "$-\tau_{br\,load} + \tau_W$" is negative).

The torque characteristic can be determined using the values calculated for the motor torque.

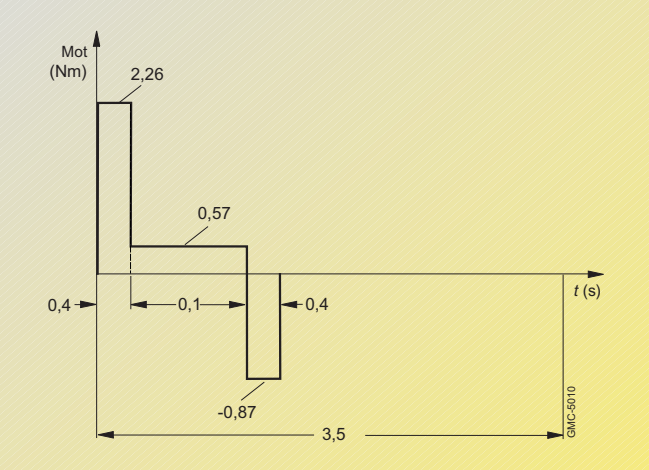



Fig. 6/15
Torque characteristic for forwards travel

- The effective motor torque is obtained from the torque characteristic as follows:

$$\tau_{eff} = \sqrt{\frac{\sum \tau_{Mot\,i}^2 \cdot \Delta t_i}{T'}}$$

$$= \sqrt{\frac{2.26^2 \cdot 0.4 + 0.57^2 \cdot 0.1 + 0.87^2 \cdot 0.4}{3.5}} = 0.82\ \text{Nm}$$

- By using the travel curve, which is proportional to the speed, the mean motor speed is obtained:

$$n_{mean} = \frac{\sum \frac{|n_B + n_E|}{2} \cdot \Delta t_i}{T'}$$

$$= \frac{\frac{1909.9}{2} \cdot 0.4 + 1909.9 \cdot 0.1 + \frac{1909.9}{2} \cdot 0.4}{3.5} = 272.8\ \text{rpm}$$

The effective motor torque calculated at $n_{mean}$ is below the S1 curve. The motor is therefore suitable.

## Calculating the z-axis as the lifting drive

### 1. Drive data

- Mass to be transported — $m$ = 200 kg
- Pinion diameter — $D$ = 0.1 m
- Max. speed — $v_{max}$ = 1.5 m/s
- Max. acceleration and deceleration — $a_{max}$ = 2.5 m/s$^2$
- Lifting height — $h$ = 1.35 m
- Cycle time — $T$ = 7 s
- Mech. efficiency — $\eta_{mech}$ = 0.9
- Mech. accuracy — $\Delta s_{mech}$ = ±0.1 mm
- Overall accuracy required — $\Delta s_{tot}$ = ±0.2 mm

### 2. Travel curve

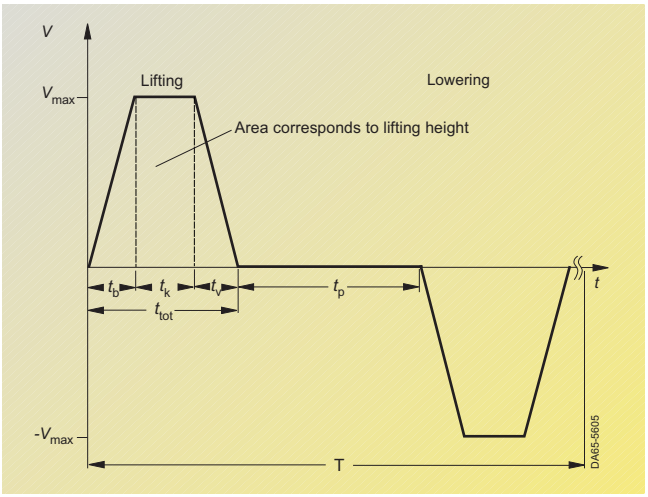



Fig. 6/16
Travel curve for lifting and lowering

The travel curve for lifting and lowering is symmetrical.
Since the lifting torque and the lowering torque are different, however, the whole travel curve has to be considered.

- The following is obtained for the missing values of the travel curve:

$$t_b = t_v = \frac{v_{max}}{a_{max}} = \frac{1.5}{2.5} = 0.6 \text{ s}$$

$$t_k = \frac{h - v_{max} \cdot \frac{t_b}{2} - v_{max} \cdot \frac{t_v}{2}}{v_{max}} = \frac{1.35 - 1.5 \cdot \frac{0.6}{2} - 1.5 \cdot \frac{0.6}{2}}{1.5} = 0.3 \text{ s}$$

$$t_{tot} = t_b + t_k + t_v = 0.6 + 0.3 + 0.6 = 1.5 \text{ s}$$

$$t_p = \frac{T}{2} - t_{tot} = 3.5 - 1.5 = 2 \text{ s}$$

## Calculating example

### 3. Max. speed under load, max. torque under load, selection of gear unit

• Max. speed under load at the pinion

$$n_{load\,max} = \frac{v_{max} \cdot 60}{\pi \cdot D} = \frac{1.5 \cdot 60}{\pi \cdot 0.1} = 286.5 \text{ rpm}$$

Here, a gear transmission ratio of $i = 10$ is selected.
A synchronous servomotor with a rated speed of 3000 rpm can therefore be used.

$$n_{Mot\,max} = i \cdot n_{load\,max} = 10 \cdot 286.5 = 2865 \text{ rpm}$$

• Lifting torque

$$\tau_H = m \cdot g \cdot \frac{D}{2} = 200 \cdot 9.81 \cdot \frac{0.1}{2} = 98.1 \text{ Nm}$$

• Acceleration and deceleration torque for the load

$$\alpha_{load} = a_{max} \cdot \frac{2}{D} = 2.5 \cdot \frac{2}{0.1} = 50 \text{ s}^{-2}$$

$$J_{load} = m \cdot \left(\frac{D}{2}\right)^2 = 200 \cdot \left(\frac{0.1}{2}\right)^2 = 0.5 \text{ kgm}^2$$

$$\tau_{a,\,br\,load} = J_{load} \cdot \alpha_{load} = 0.5 \cdot 50 = 25 \text{ Nm}$$

• Max. torque on the output side of the gear unit

$$\tau_{load\,max} = (\tau_{b\,load} + \tau_H) \cdot \frac{1}{\eta_{mech}} = (25 + 98.1) \cdot \frac{1}{0.9} = 136.8 \text{ Nm}$$

A planetary gear unit for mounting on 1FT6 motors is selected with

$\tau_{max} = 400$ Nm when $i = 10$

$J^*_G = 0.001$ kgm$^2$ moment of inertia referred to the motor
$\eta_G = 0.95$ gear unit efficiency
$\alpha_G = 3'$ torsional play

• Acceleration and deceleration torque for the gear unit

$$\tau_{a,\,br\,G} = J^*_G \cdot \alpha_{load} \cdot i = 0.001 \cdot 50 \cdot 10 = 0.5 \text{ Nm}$$

• Positioning accuracy

$$\Delta s_{gear} = \frac{D \cdot \pi}{360°} \cdot \frac{\alpha_G}{60} = \frac{0.1 \cdot \pi}{360} \cdot \frac{3}{60} = 0.0436 \text{ mm}$$

i.e. ±0.0218 mm

$$\Delta s_{encoder} = \frac{D \cdot \pi}{i \cdot z} = \frac{0.1 \cdot \pi}{10 \cdot 1024} = \pm 0.0306 \text{ mm}$$

with an 2-pole resolver

$$\Delta s_{tot} = \Delta s_{mech} + \Delta s_{gear} + \Delta s_{encoder}$$
$$= 0.1 + 0.0218 + 0.0306 = 0.1518 < 0.2 \text{ mm}$$

The accuracy requirement is thus satisfied.

### 4. Selection of motor

Selection in relation to the dynamic limit curve

• The max. motor torque here occurs during acceleration upwards since the deceleration is equal to the acceleration and the drive, during lifting, also has to overcome the levels of efficiency.

$$\tau_{Mot\,max} = \tau_{a\,Mot} + \tau_{a\,G} + (\tau_{a\,load} + \tau_H) \cdot \frac{1}{i \cdot \eta_{mech} \cdot \eta_G}$$

$$= \tau_{a\,Mot} + 0.5 + (25 + 98.1) \cdot \frac{1}{10 \cdot 0.9 \cdot 0.95}$$

$$= \tau_{a\,Mot} + 14.9 \text{ Nm}$$

with $\tau_{a\,Mot} = J_{Mot} \cdot \alpha_{load} \cdot i = J_{Mot} \cdot 50 \cdot 10 = J_{Mot} \cdot 500 \text{ s}^{-2}$

The first 1FT6 motor with $n_n = 3000$ rpm, which satisfies the condition or matches the dynamic limit curve, is the 1FT6082–8AF7 with $P_n = 3.2$ kW, $\tau_n = 10.3$ Nm, $\tau_{max\,perm} = 42$ Nm, $J_{Mot} = 0.00335$ kgm$^2$ (with brake), $k_{Tn100} = 1.18$ Nm/A, $\eta_{Mot} = 0.89$, $\tau_0 = 13$ Nm

• The acceleration and deceleration torque for the motor rotor is thus

$$\tau_{a,\,br\,Mot} = 0.00335 \cdot 500 = 1.68 \text{ Nm}$$

• The max. motor torque is equal to the motor torque during acceleration:

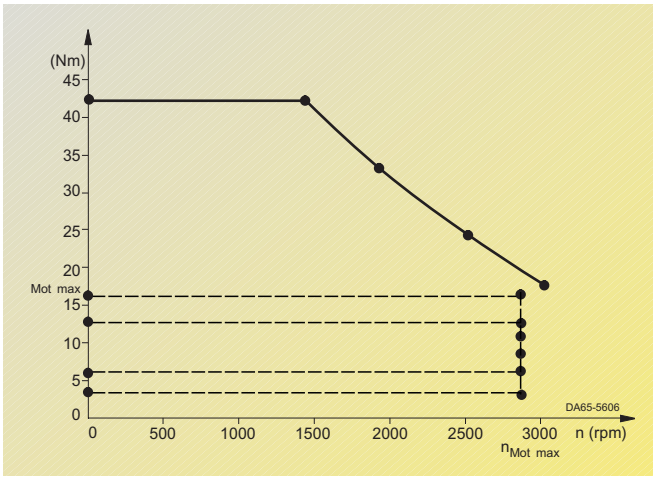



Fig. 6/17
Dynamic limit curve for the 1FT6082–8AF7 with the points of the load cycle

In order to check the thermal limits, the effective motor torque is calculated. For this purpose, all other motor torques within the travel curve have to be calculated, in addition to the motor torque during acceleration.

- Lifting of the load, motor torque during constant travel

$$\tau_{\text{Mot k up}} = \tau_{\text{H}} \cdot \frac{1}{i \cdot \eta_{\text{mech}} \cdot \eta_{\text{G}}} = 98.1 \cdot \frac{1}{10 \cdot 0.9 \cdot 0.95} = 11.47 \text{ Nm}$$

- Lowering of the load, motor torque during constant travel

$$\tau_{\text{Mot k down}} = \tau_{\text{H}} \cdot \frac{\eta_{\text{mech}} \cdot \eta_{\text{G}}}{i} = 98.1 \cdot \frac{0.9 \cdot 0.95}{10} = 8.39 \text{ Nm}$$

- Lifting of the load, motor torque during deceleration

$$\tau_{\text{Mot up}} = -\tau_{\text{br Mot}} - \tau_{\text{br G}} + (-\tau_{\text{br load}} + \tau_{\text{H}}) \cdot \frac{1}{i \cdot (\eta_{\text{mech}} \cdot \eta_{\text{G}})^{\text{sign}(-\tau_{\text{br load}} + \tau_{\text{H}})}}$$

$$= -1.68 - 0.5 + (-25 + 98.1) \cdot \frac{1}{10 \cdot 0.9 \cdot 0.95} = 6.37 \text{ Nm}$$

Lowering of the load, motor torque during acceleration

$$\tau_{\text{Mot a down}} = -\tau_{\text{a Mot}} - \tau_{\text{a G}} + (-\tau_{\text{a load}} + \tau_{\text{H}}) \cdot \frac{(\eta_{\text{mech}} \cdot \eta_{\text{G}})^{\text{sign}(-\tau_{\text{a load}} + \tau_{\text{H}})}}{i}$$

$$= -1.68 - 0.5 + (-25 + 98.1) \cdot \frac{0.9 \cdot 0.95}{10} = 4.08 \text{ Nm}$$

- Lowering of the load, motor torque during deceleration

$$\tau_{\text{Mot br down}} = \tau_{\text{br Mot}} + \tau_{\text{br G}} + \tau_{\text{br load}} + \tau_{\text{H}} \cdot \frac{(\eta_{\text{mech}} \cdot \eta_{\text{G}})}{i}$$

$$= 1.68 + 0.5 + (25 + 98.1) \cdot \frac{0.9 \cdot 0.95}{10} = 12.7 \text{ Nm}$$

The motor curve can be determined with the help of the values calculated for the motor torque.

- The effective motor torque is obtained from the torque characteristic as follows:

$$\tau_{\text{eff}} = \sqrt{\frac{\sum \tau_{\text{Mot i}}^2 \cdot \Delta t_{\text{i}}}{T}}$$

$$= \sqrt{\frac{16.58^2 \cdot 0.6 + 11.47^2 \cdot 0.3 + 6.37^2 \cdot 0.6 + 4.08^2 \cdot 0.6 + 8.39^2 \cdot 0.3 + 12.7^2 \cdot 0.6}{7}}$$

$$= 7.14 \text{ Nm}$$

- The speed-proportional travel curve is used to obtain the mean motor speed as follows:

$$n_{\text{mean}} = \frac{\sum \frac{|n_{\text{B}} + n_{\text{E}}|}{2} \cdot \Delta t_{\text{i}}}{T}$$

$$= \frac{\frac{2865}{2} \cdot 0.6 + 2865 \cdot 0.3 + \frac{2865}{2} \cdot 0.6 \cdot 2}{7} = 736.7 \text{ rpm}$$

(due to the symmetry of the travel curve, the component for lifting is multiplied by 2)

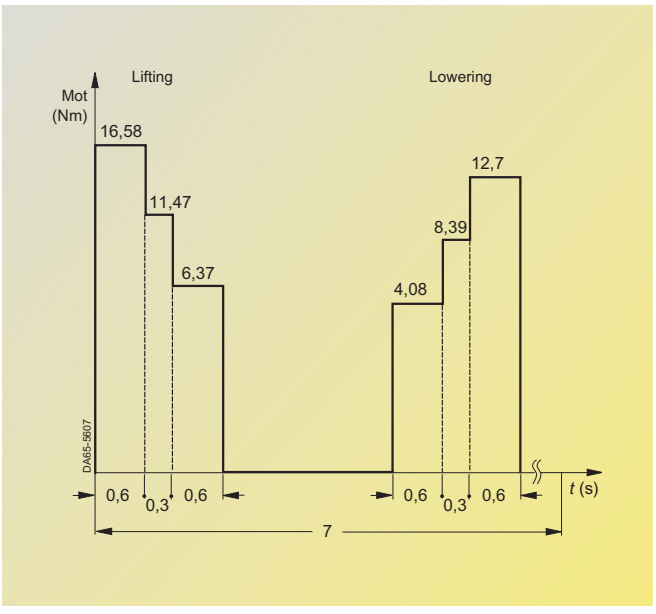



Fig. 6/18
Torque characteristic for lifting and lowering

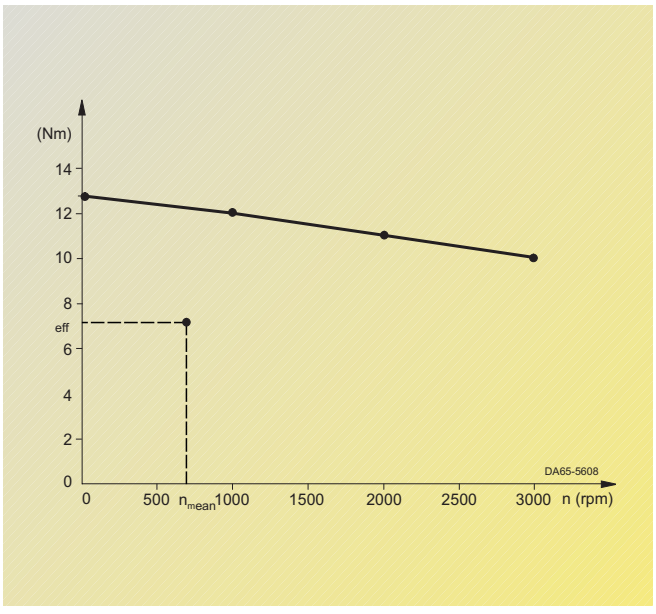



Fig. 6/19
S1 curve for the 1FT6082–8AF7

The calculated effective motor torque at $n_{\text{mean}}$ is below the S1 curve. The motor is therefore suitable.

## Calculating example

### Calculation of the x, y, z-axis

**5. Cooling methods**

For this application internal cooling for all modules is chosen.

**6. Configuration of the drive modules**

*X-axis*

The power module is selected according to the maximum motor current and the mean value of the motor current.

- Maximum motor current (the saturation influence can be neglected here)

$$I_{\text{Mot max}} \approx \frac{\tau_{\text{Mot max}}}{k_{\text{Tn100}}} = \frac{31.03}{1.34} = 23.16\ \text{A}$$

- Mean value of the motor current obtained from the magnitude of the torque characteristic

$$I_{\text{Mot mean}} \approx \frac{\sum |\tau_{\text{Mot i}}| \cdot \Delta t_i}{k_{\text{Tn100}} \cdot T'}$$

$$= \frac{31.03 \cdot 0.25 + 3.21 \cdot 1 + 19.83 \cdot 0.25}{1.34 \cdot 3.5} = 3.4\ \text{A}$$

Now the overload capability of the power module has to be taken into consideration. Because the accelerating and decelerating times are ≤ 2,65 s[1]), the two times overload capability with 1FT6 synchronous servo motors can be used.[2])

- Thus:

$I_{\text{Mot max}} = 23.16\ \text{A} < I_{\text{max}} = 36\ \text{A}$

$I_{\text{Mot mean}} = 3.4\ \text{A} < I_{\text{n}} = 18\ \text{A}$

A 6SN11 23-1AA00-0CA1 1-axis power module can be used.

*Z-axis*

The power module is selected according to the maximum motor current and the mean motor current.

- Maximum motor current (the saturation influence here can be ignored)

$$I_{\text{Mot max}} \approx \frac{\tau_{\text{Mot max}}}{k_{\text{Tn100}}} = \frac{16.57}{1.18} = 14\ \text{A}$$

- Mean motor current, obtained from the magnitude of the torque characteristic

$$I_{\text{Mot mean}} \approx \frac{\sum |\tau_{\text{Mot i}}| \cdot \Delta t_i}{k_{\text{Tn100}} \cdot T}$$

$$= \frac{16.58 \cdot 0.6 + 11.47 \cdot 0.3 + 6.37 \cdot 0.6 + 4.08 \cdot 0.6 + 8.39 \cdot 0.3 + 12.7 \cdot 0.6}{1.18 \cdot 7} = 3.6\ \text{A}$$

Now the overload capability of the power module has to be taken in consideration. Because the accelerating and decelerating times are ≤ 2,65 s[1]), the two times overload capability with 1FT6 synchronous servo motors can be used.

$I_{\text{Mot max}} = 14\ \text{A} < I_{\text{max}} = 18\ \text{A}$

$I_{\text{Mot mean}} = 3.6\ \text{A} < I_{\text{n}} = 9\ \text{A}$

A 6SN11 23-1AA00-0CA1 1-axis power module can be used.

To save space in the cabinet the 2-axis 6SN11 23-1AB00-0CA1 can be used instead of two single power modules.

*Y-axis*

For the 1FT60 41-4AF7 the smallest 1-axis power module 6SN11 23-1AA00-0HA1 with $I_{\text{n}} = 3$ A and $I_{\text{max}} = 6$ A is selected. Because the drive of the y-axis always runs alone and, with regard to its power, is small in comparison to the drives of the x-axis and the z-axis, it is not taken into account in the rating of the braking resistor.

*Plug-in units*

Because of the resolver feedback devices and the need for position control, the following selections can be made:

| | Plug-in unit |
|---|---|
| With 2-axis power module: For x- and z-axis | 6SN11 18-1NK00-0AA1 |
| With 1-axis power module: For y-axis | 6SN11 18-1NJ00-0AA1 |

1) See chapter dimensioning of the power module-overload capability.

2) Overload capability of 1PH asynchronous servomotors varies.

### 7. Selection of the infeed module

• Maximum DC link power, worst case:

$$P_{Mot\,X} = \frac{\tau_{Mot_{max}} \cdot n_{Mot_{max}}}{9550} = \frac{31.03\ Nm \cdot 2183\ rpm}{9550} = 7.09\ kW$$

$$P_{Mot\,Y} = \frac{\tau_{Mot_{max}} \cdot n_{Mot_{max}}}{9550} = \frac{2.26\ Nm \cdot 1909.9\ rpm}{9550} = 0.45\ kW$$

$$P_{Mot\,Z} = \frac{\tau_{Mot_{max}} \cdot n_{Mot_{max}}}{9550} = \frac{16.58\ Nm \cdot 2865\ rpm}{9550} = 4.97\ kW$$

$$P_{DC\ link_x} = \frac{P_{Mot_x}}{\eta_{power\ module} \cdot \eta_{Mot}} = \frac{7.09}{0.98 \cdot 0.91} = 7.95\ kW$$

$$P_{DC\ link_y} = \frac{P_{Mot_y}}{\eta_{power\ module} \cdot \eta_{Mot}} = \frac{0.45}{0.98 \cdot 0.85} = 0.54\ kW$$

$$P_{DC\ link_z} = \frac{P_{Mot_z}}{\eta_{power\ module} \cdot \eta_{Mot}} = \frac{4.97}{0.98 \cdot 0.90} = 5.63\ kW$$

Simply adding the maximum DC link power values of the three axes would result in an oversized infeed module, since first of all not all axes are running at the same time and second not all maximums are occurring simultaneously.

In this example the x- and z-axes are operating simultaneously while the y-axis only operates when the other axes are stopped. This operating sequence results in two independent maximums. One is the combined maximum of the x- and z-axes the other power maximum of the y-axis. The infeed module only needs to supply the greater of the two maximums.

From the calculation above it is obvious that the maximum DC link power requirement of the y-axis is negligible versus the other axes. Hence the maximum power capability of the infeed module is sufficiently sized if it fulfills the maximum power requirement of the simultaneously operated x- and z-axes.

If the x- and z-axes's maximums occurred simultaneously the maximum DC link power would be:

$$\sum P_{DC\ link\ max} = P_{DC\ link_x} + P_{DC\ link_z} = 7.95 + 5.63 = 13.58\ kW$$

However, considering that these maximum power values are not occurring at the exact same time leads to a lower $P_{DC\ link\ max}$ requirement as can be seen in the following graphs.

• Max. DC link power, with consideration of the simultaneity:

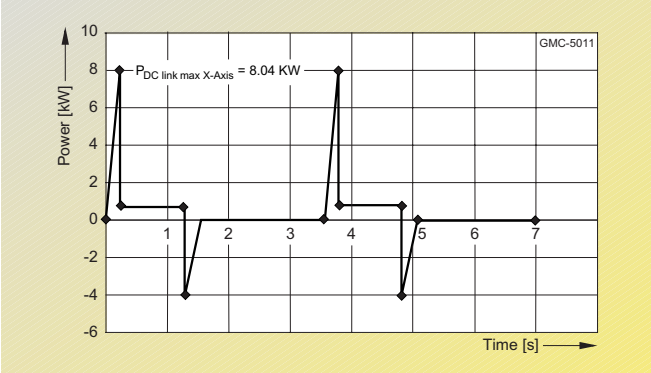



Fig. 6/20
Power profile x-axis[1])

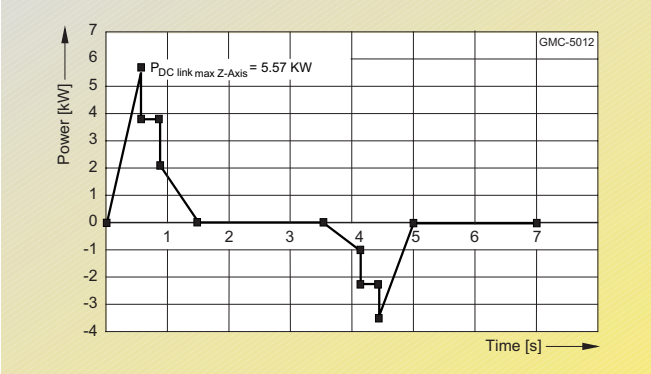



Fig. 6/21
Power profile z-axis[1])

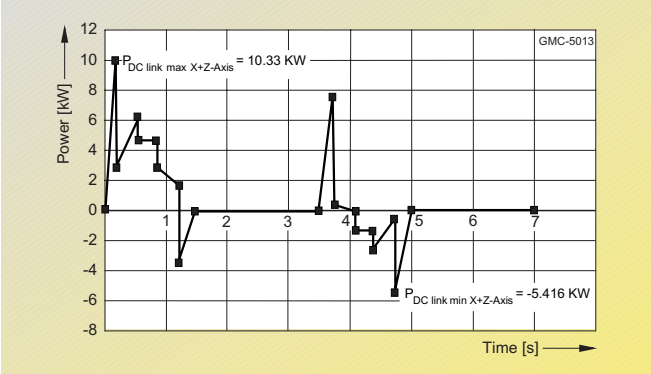



Fig. 6/22
Power profile x and z-axis

You can see the difference between the exact and the worst case calculated DC link power:

$P_{DC\ link\ max\ worst\ case}$ = 13.58 kW
$P_{DC\ link\ max\ exact}$ = 10.33 kW

1) The graphs would be generated in SIMOSIZE.

## Calculating example

- Rated DC link power (RMS)

$$P_{\text{Mot RMS}_x} = \sqrt{\frac{\sum\left(\frac{P_{\text{Mot B}} + P_{\text{Mot E}}}{2}\right)^2 \cdot \Delta t_i}{T}} = \sqrt{\frac{\left(\frac{7.09 \cdot 0.25}{2}\right)^2 + (0.734 \cdot 1)^2}{3.5}} = 0.62\ \text{kW}$$

$$P_{\text{Mot RMS}_z} = \sqrt{\frac{\sum\left(\frac{P_{\text{Mot B}} + P_{\text{Mot E}}}{2}\right)^2 \cdot \Delta t_i}{T}} = \sqrt{\frac{\left(\frac{4.97 \cdot 0.6}{2}\right)^2 + (3.44 \cdot 0.3)^2 + \left(\frac{1.91 \cdot 0.6}{2}\right)^2}{7}} = 0.72\ \text{kW}$$

$$P_{\text{n DC link}} = \frac{\sum\left(\frac{P_{\text{Mot RMS}}}{\eta_{\text{power module}} \cdot \eta_{\text{Mot}}}\right)}{X} = \frac{\frac{0.62}{0.98 \cdot 0.91} + \frac{0.72}{0.98 \cdot 0.90}}{1.03} = 1.47\ \text{kW}$$

- Selection of the infeed module

***Non regenerative infeed module:***

The next appropriate size of the infeed module is the 6SN11 45-1AA01-0AA1 non regenerative 10/25 kW unit.

$P_{\text{DC link max exact}} = 10.33\ \text{kW} < 25\ \text{kW}$
$P_{\text{n DC link}} = 1.47\ \text{kW} < 10\ \text{kW}$

Unfortunately the exact calculated max. DC link power is a bit more than 10 kW, so we have to choose the next bigger non regenerative infeed module.

***Regenerative infeed module:***

In this case we have to choose 6SN11 45-1BA01-0BA1, which is the smallest available size. With regenerative infeed module, the regenerative DC link power in braking operation has to be taken into consideration, when it is higher than the DC link power in drive operation.

$P_{\text{DC link max exact}} = 10.33\ \text{kW} < 35\ \text{kW}$
$P_{\text{n DC link}} = 1.47\ \text{kW} < 16\ \text{kW}$

- Checking the 24 V DC Power Supply Rating

*Non regenerative infeed module:*

| **Module type** | Electronic points | | | Gating points | | | DC link capacity | | |
|---|---|---|---|---|---|---|---|---|---|
| | Provides | Requires | Resultant | Provides | Requires | Resultant | Capacity limit of infeed module ($\mu$F) | DC link capacity utilization ($\mu$F) | Braking utilization ($\mu$F) |
| O/I module 10/25 kW | 8 | 0.5 | 7.5 | 17 | 0.5 | 16.5 | 6000 | 440 | 0 |
| Drive module 2-axis 18/36 A | 0 | 1.8 | 5.7 | 0 | 2.4 | 14.1 | | 660 | 660 |
| Drive module 2-axis 3/6 A | 0 | 1.7 | 4 | 0 | 2.1 | 12 | | 75 | 75 |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | Resultant electronic points[1] (must be > 0) | | 4 | Resultant gating points[1] (must be > 0) | | 12 | Σ DC link utilization < limit of infeed module | 1175 | |
| | | | | | | | Σ braking utilization[2] | | 735 |

*Regenerative infeed module:*

| **Module type** | Electronic points | | | Gating points | | | DC link capacity | | |
|---|---|---|---|---|---|---|---|---|---|
| | Provides | Requires | Resultant | Provides | Requires | Resultant | Capacity limit of infeed module ($\mu$F) | DC link capacity utilization ($\mu$F) | Braking utilization ($\mu$F) |
| I/RF module 16/35 kW | 8 | 0.5 | 7.5 | 17 | 0.5 | 16.5 | 6000 | 495 | 0 |
| Drive module 2-axis 18/36 A | 0 | 1.8 | 5.7 | 0 | 2.4 | 14.1 | | 660 | 660 |
| Drive module 2-axis 3/6 A | 0 | 1.7 | 4 | 0 | 2.1 | 12 | | 75 | 75 |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | Resultant electronic points[1] (must be > 0) | | 4 | Resultant gating points[1] (must be > 0) | | 12 | Σ DC link utilization < limit of infeed module | 1230 | |
| | | | | | | | Σ braking utilization[2] | | 735 |

In both applications no monitoring module is necessary, because the gating and electronic points are sufficient.

**All of the required data values are found in Table 1!**

1) If resultant goes negative during calculation, a Monitoring module must be added. Start with the 8 electronic points and 17 gating points provided by the monitoring module.
2) Max. number of permissible braking resistors is equal to the integer value of Σ braking utilization/500 $\mu$F: Example 1) 1200 $\mu$F/500 $\mu$F = 2.4 = > max. 2
2) 1900 $\mu$F/500 $\mu$F = 3.8 = > max. 3

### 8. Selection of the braking unit and braking resistor

In the 10/25 kW O/I[1]) infeed module an internal pulsed resistor with 300 W cont. rating and 25 kW short-time rating is included. For I/RF[2]) infeed module a pulsed resistor would only be necessary for emergency braking. Because of the small load of the y-axis and it running separately, this axis does not have to be taken into consideration.

***Non regenerative infeed module:***

$$P_{\text{max br x-axis}} = P_{\text{Mot br max}} \cdot \eta_{\text{Mot}} \cdot \eta_{\text{power module}} =$$
$$= -4.53 \cdot 0.91 \cdot 0.98 = -4.04 \text{ kW}$$

$$P_{\text{max br z-axis}} = P_{\text{Mot br max}} \cdot \eta_{\text{Mot}} \cdot \eta_{\text{power module}} =$$
$$= -3.81 \cdot 0.90 \cdot 0.98 = -3.36 \text{ kW}$$

$$P_{\text{Mot br}} = P_{\text{max br x-axis}} + P_{\text{max br z-axis}} = -4.04 + (-3.36) = -7.4 \text{ kW}$$

$$P_{\text{Mot br mean x-axis}} = \frac{\sum \frac{P_{\text{Mot br B}} + P_{\text{Mot br E}}}{2} \cdot \Delta t_i}{T} =$$
$$= \frac{\frac{-4.53}{2} \cdot 0.25}{3.5} = -0.155 \text{ kW}$$

$$P_{\text{max br mean z-axis}} = \frac{\sum \frac{P_{\text{Mot br B}} + P_{\text{Mot br E}}}{2} \cdot \Delta t_i}{T} =$$
$$= \frac{\frac{-1.22}{2} \cdot 0.6 + (-2.52) \cdot 0.3 + \frac{-3.81}{2} \cdot 0.6}{7} = -0.324 \text{ kW}$$

$$P_{\text{n x-axis}} = P_{\text{Mot br mean}} \cdot \eta_{\text{Mot}} \cdot \eta_{\text{power module}} =$$
$$= -0.155 \cdot 0.91 \cdot 0.98 = -0.138 \text{ kW}$$

$$P_{\text{n z-axis}} = P_{\text{Mot br mean}} \cdot \eta_{\text{Mot}} \cdot \eta_{\text{power module}} =$$
$$= -0.324 \cdot 0.90 \cdot 0.98 = -0.286 \text{ kW}$$

$$P_{\text{n}} = P_{\text{n x-axis}} + P_{\text{n z-axis}} = -0.138 + (-0.286) = -0.424 \text{ kW}$$

$$P_{\text{max br resistor}} \geq P_{\text{max br}} = 25 \text{ kW} \geq 7.4 \text{ kW: O.K.}$$

$$P_{\text{n resistor}} \geq P_{\text{n}} = 0.3 \geq 0.424 \text{ kW!!!: Not O.K.}$$

This means, a separate pulsed resistor 6SN11 13-1AA00-0CA0 has to be used. For the 10/25 kW O/I infeed module also a pulsed resistor module 6SN11 13-1AB01-0BA1 has to be used. The gating points, electronic points and the DC link capacitance has also to be taken into consideration.

***Regenerative infeed module:***
No braking unit is necessary.

### 9. Selection of other Components

Other components can be selected as needed. For example:

- Profibus Communication module
- Shield plates, etc.

1) Non regenerative unit.

2) Regenerative unit.

## Legend

| Math Symbol | Definition |
|---|---|
| $\Delta S_{Gear}$ | Positioning accuracy of gear box |
| $\Delta S_{Encoder}$ | Positioning accuracy of encoder |
| $\Delta S_{mech}$ | Imprecision of the mechanical system |
| $\Delta S_{Total}$ | Positioning accuracy of the total system |
| $\alpha_G$ | Angular rotation of gear box |
| $D$ | Diameter (in length) |
| $\pi$ | Pi |
| $Z$ | Pulses per revolution of encoder |
| $i$ | Gear ratio |
| $n_n$ | Rated speed in RPM |
| $\tau_{a\ Mot}$ | Accelerating torque needed for accelerating the motor rotor moment of inertia |
| $\tau_{*\ load\ max}$ | Maximum load torque converted to the motor speed during the acceleration phase, including the contribution of the gearbox |
| $\tau_{Mot\ max}$ | Maximum motor torque |
| $\alpha_{a\ Mot}$ | Angular acceleration of the motor |
| $\tau_{rms}$ | Total RMS torque |
| $\tau_{Mot\ i}$ | Motor torque in the time segment "$i$" |
| $\Delta T_i$ | Time segment "$i$" in seconds |
| $T$ | Total cycle time |
| $n_{mean}$ | Total mean speed in RPM |
| $n_{Mot\ B}$ | Beginning value of motor speed in RPM |
| $n_{Mot\ E}$ | Ending value of motor speed in RPM |
| $J_{Mot}$ | Inertia of motor rotor |
| $I_{rms}$ | Motor RMS current |
| $I_n$ | Rated motor current |
| $I_{Mot}$ | Motor current at a given part of the motion curve |
| $\tau_{\mu n}$ | Rated Magnetizing current |
| $I_{Mot\ B}$ | Beginning value of motor current |
| $I_{Mot\ E}$ | Ending value of motor current |
| $Kt_n$ | Motor torque constant |
| $P_{n\ DC\ link}$ | Rated DC link power |
| $P_{n\ resistor}$ | Rated power pulsed resistor |
| $P_{Mot}$ | Motor power in kW |
| $I_{DC,\ Rect}$ | DC bus current required by rectifier |
| $I_{DC,\ Inv}$ | DC bus current required from inverter |
| $V_{DC}$ | DC bus voltage |
| $\eta_{Inv}$ | Efficiency of inverter |
| $\eta_{Mot}$ | Efficiency of motor |
| $V_{line}$ | AC line voltage |
| $W_s$ | Storage capacity of capacitor in Watt*Seconds |
| $V_{DC\ n}$ | Rated DC bus voltage |
| $V_{DC\ min}$ | Minimum allowable DC bus voltage |
| $\tau_{Mot\ br\ max}$ | Maximum motor torque during braking |
| $t_{rt}$ | Power dip ride through time |
| $P_{br\ max}$ | Maximum braking power |
| $t_{br}$ | Braking time |
| $W_{br}$ | Braking energy |

## Calculating example

Based upon the results of the previous calculation the following design and parts for the 611 universal drive system were selected.

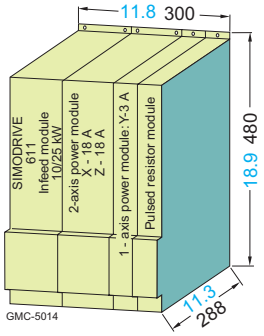



Fig. 6/23

| Description | Order No. | Quantity | Motor |
|---|---|---|---|
| Motor, DC link 600 V, 2.5 Nm, 100 K, 3000 rpm, air cooling, IM B 5, power and signal connectors IM B 5, for power and signal connector, outgoing connector direction axial, non-drive end, resolver, smooth shaft, accuracy tolerance N, holding brake vibration severity grade N, diaphragm seal (IP 64) | **1FT60 41-4AF71-3TH0** | 1 | Y |
| Motor, VDC link 600 V, 13 Nm, 100 K, 3000 rpm; resolver, air cooling, IP 65, IM B 5, power and signal connectors, connector outgoing direction, traverse right, holding brake | **1FT60 82-1AF71-1TH1** | 1 | Z |
| Motor, VDC link 600 V, 20 Nm, 100 K, 3000 rpm; resolver, air cooling, IP 65, IM B 5, power and signal connectors, connector outgoing direction, traverse right, holding brake | **1FT60 84-1AF71-1TH1** | 1 | X |
| SIMODRIVE connecting elements, signal cable, length (m) = + 10 | **6FX40 02-2CF02-1BA0** | 3 | X Y Z |
| Power cable, preassembled, 4 X 1.5 C,<br>• Connector size 1<br>• Connector size 1.5<br>$d_{max.}$ = 10.4 mm, length (m) = + 10 | <br>**6FX40 02-5CA01-1BA0**<br>**6FX40 02-5CA21-1BA0** | <br>1<br>2 | <br>Y<br>X Z |
| SIMODRIVE 611 universal<br>• Mains filter[2]) for unregulated power supply 10 kW<br>• Surge arrester[3]) for power supply > 10 kW, for internal and external cooling<br>• Pulsed resistor 1.5/25 kW for external fitting<br>• Pulsed resistor module, internal resistance for 0.3/25 kW universal housing for 211/288 mm depth | <br>**6SN11 11-0AA01-1AA0**<br>**6SN11 11-0AB00-0AA0**<br>**6SN11 13-1AA00-0CA0**<br>**6SN11 13-1AB01-0BA1** | <br>1<br>1<br>1<br>1 | |
| SIMODRIVE 611 universal digital closed-loop control plug-in unit, connecting for resolver, positioning or position setpoint interface for 1FT6, 1FK6, 1FE1, 1FN1/2 1PH2/4/6/7 standard motors, fitted for plug-in option<br>• 1-axis<br>• 2-axes | <br>**6SN11 18-1NJ00-0AA1**<br>**6SN11 18-1NK00-0AA1** | <br>1<br>1 | <br>Y<br>X Z |
| MOTION CONTROL with PROFIBUS-DP synchronous norm-slave up to 2 axes only for cyclic and acyclic data exchange upto 12 MBaud | **6SN11 14-0NB01-0AA0** | 2 | |
| SIMODRIVE 611 power module<br>• 1-axis, 8 A, internal cooling, motor rated current: 1FT6 = 3 A, induction motor = 3 A<br>• 2-axes, 50 A, internal cooling, motor rated current: 1FT6 = 18 A | <br>**6SN11 23-1AA00-0HA1**<br>**6SN11 23-1AB00-0CA1** | <br>1<br>1 | <br>Y<br>X Z |
| SIMODRIVE 611 infeed module, 10/25 kW, unregulated, internal/external cooling, mains contactor with break contact | **6SN11 45-1AA01-0AA1** | 1 | |
| SIMODRIVE 611 heat conduction canopy[4]) for unregulated power supply 10 kW | **6SN11 62-0BA01-0AA0** | 1 | |
| SIMODRIVE 611 shield connecting plate for internal cooling[5]),<br>• Module width 1.97 in (50 mm)<br>• Module width 3.94 in (100 mm) | <br>**6SN11 62-0EA00-0AA0**<br>**6SN11 62-0EA00-0BA0** | <br>2<br>2 | |

1) Unregulated/non regenerative unit.
2) To reach permissible EMC values.
3) Needed to comply to UL Standard.
4) Must be used when max. capacity utilization of the pulsed resistor >200 W.
5) Needed for grounding infeed-, power-, pulsed resistor- and monitoring modules.

## Calculating example

Based upon the results of the previous calculation the following design and parts for the 611 universal drive system were selected.

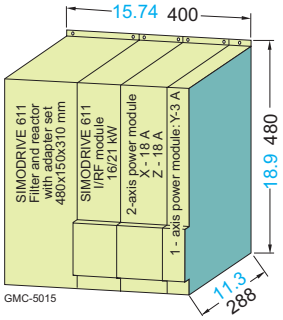



Fig. 6/24

| Description | Order No. | Quantity | Motor |
|---|---|---|---|
| Motor, DC link 600 V, 2.5 Nm, 100 K, 3000 rpm, air cooling, IM B 5, power and signal connectors IM B 5, for power and signal connector, outgoing connector direction axial, non-drive end, resolver, smooth shaft, accuracy tolerance N, holding brake vibration severity grade N, diaphragm seal (IP 64) | **1FT60 41-4AF71-3TH0** | 1 | Y |
| Motor, VDC link 600 V, 13 Nm, 100 K, 3000 rpm; resolver, air cooling, IP 65, IM B 5, power and signal connectors, connector outgoing direction, traverse right, holding brake | **1FT60 82-1AF71-1TH1** | 1 | Z |
| Motor, VDC link 600 V, 20 Nm, 100 K, 3000 rpm; resolver, air cooling, IP 65, IM B 5, power and signal connectors, connector outgoing direction, traverse right, holding brake | **1FT60 84-1AF71-1TH1** | 1 | X |
| SIMODRIVE connecting elements, signal cable, length (m) = + 10 | **6FX40 02-2CF02-1BA0** | 3 | X Y Z |
| Power cable, preassembled, 4 X 1.5 C,<br>• Connector size 1<br>• Connector size 1.5<br>$d_{max.}$ = 10.4 mm, length (m) = + 10 | <br>**6FX40 02-5CA01-1BA0**<br>**6FX40 02-5CA21-1BA0** | <br>1<br>2 | <br>Y<br>X Z |
| • Filter package[2]) 16 kW, contains: HF commutating reactor and mains filter<br>• Surge arrester[3]) for power supply > 10 kW, for internal and external cooling | **6SN11 11-0AA01-2BB0**<br>**6SN11 11-0AB00-0AA0** | 1<br>1 | |
| SIMODRIVE 611 universal digital closed-loop control plug-in unit, connecting for resolver, positioning or position setpoint interface for 1FT6, 1FK6, 1FE1, 1FN1/2 1PH2/4/6/7 standard motors, fitted for plug-in option<br>• 1-axis<br>• 2-axes | <br>**6SN11 18-1NJ00-0AA1**<br>**6SN11 18-1NK00-0AA1** | <br>1<br>1 | <br>Y<br>X Z |
| MOTION CONTROL with PROFIBUS-DP synchronous norm-slave up to 2 axes only for cyclic and acyclic data exchange upto 12 MBaud | **6SN11 14-0NB01-0AA0** | 2 | |
| SIMODRIVE 611 power module<br>• 1-axis, 8 A, internal cooling, motor rated current: 1FT6 = 3 A, induction motor = 3 A<br>• 2-axes, 50 A, internal cooling, motor rated current: 1FT6 = 18 A | <br>**6SN11 23-1AA00-0HA1**<br>**6SN11 23-1AB00-0CA1** | <br>1<br>1 | <br>Y<br>X Z |
| SIMODRIVE 611 infeed/regenerative feedback module 16/21 kW, stabilized, with internal cooling, mains contactor with break contact | **6SN11 45-1BA01-0BA1** | 1 | |
| SIMODRIVE 611 shield connecting plate for internal cooling[4])<br>• Module width 1.97 in (50 mm) | <br>**6SN11 62-0EA00-0AA0** | <br>2 | |
| SIMODRIVE 611 adapter set[5]) for filter pack. 16 kW | **6SN11 62-0GA00-0BA0** | 1 | |

1) Regulated/regenerative unit.

2) Recommended, mains filters is necessary to reach permissible EMC values, HF commutating reactor is necessary for I/RF (aka. I/R) infeed modules.

3) Needed to comply to UL Standard.

4) Needed for grounding infeed-, power-, pulsed resistor and monitoring modules.

5) To adapt mains filter package to the assembly surface of the filter modules.

## HF commutating reactor

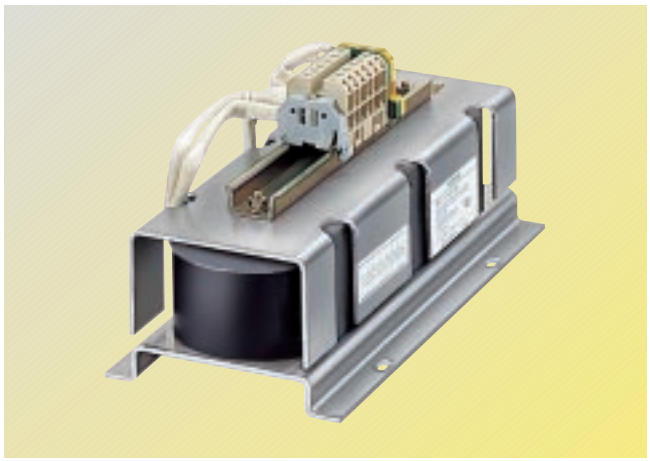


Fig. 6/25
HF commutating reactor

The matched HF commutating reactor in accordance with the selection table is required for the connection of the 28 kW unregulated control infeed modules and the closed-loop infeed/regenerative feedback modules to the mains.

HF commutating reactors for 400 V 3-phase AC –10% to 480 V 3-phase AC +6%; 50 Hz/ 60 Hz ±10%.

If the demands of EMC legislation must be met, we recommend ordering mains filter in conjunction with the HF commutating reactor or mains filter package which has both components.

For dimension drawings see chapter 7.

## Technical specifications with ordering data

HF commutating reactors, supply voltage 400/480 V 3-phase AC

| **Assignment to mains infeed module** | **HP (kW)** | **38 (28)** O/I (aka. U/E) | **22 (16)** I/RF (aka. I/R) | **49 (36)** I/RF (aka. I/R) | **75 (55)** I/RF (aka. I/R) | **109 (80)** I/RF (aka. I/R) | **160 (120)** I/RF (aka. I/R) |
|---|---|---|---|---|---|---|---|
| **Rated AC** | **A** | 65 | 30 | 67 | 103 | 150 | 225 |
| **Power loss** | **W** | 70 | 170 | 250 | 350 | 450 | 590 |
| **Max. conductor cross-section, primary/secondary side** | **mm²**<br>**AWG** | 50<br>1 | 16<br>6 | 50<br>1 | 70<br>210 | FL[1])<br> | FL[1])<br> |
| **Weight, approx.** | **lb (kg)** | 13.2 (6) | 18.7 (8.5) | 28.6 (13) | 39.6 (18) | 88 (40) | 110 (50) |
| **Dimensions (W x H x D) approx.** | **in (mm)** | 7.41 x 7.8 x 3.9 (190 x 200 x 100) | 12.87 x 5.65 x 5.85 (330 x 145 x 150) | 12.87 x 8.97 x 5.85 (330 x 230 x 150) | 12.87 x 10.92 x 5.85 (330 x 280 x 150) | 14.82 x 9.75 x 6.63 (380 x 250 x 170) | 14.82 x 11.32 x 6.63 (380 x 290 x 170) |
| **Supply voltage** | **V** | 400 3-phase AC ±10% to 480 3-phase AC +6% – 10% | | | | | |
| **Frequency** | **Hz** | 50/60 ±10% | | | | | |
| **Degree of protection** | | IP 00 in accordance with IEC 60 529 (DIN EN 60 529) | | | | | |
| **Humidity classification according to DIN EN 60 721-3-3** | | Cl. 3K5, condensation and icing excluded.<br>Low air temperature: +32 °F (0 °C) | | | | | |
| **Permissible ambient temperature**<br>**• Operation**<br>**• Storage/ transport** | <br>**°F (°C)**<br>**°F (°C)** | <br>–13 to +104 (–25 to +40), up to +131 (+55) with derating<br>–13 to +176 (–25 to +80) | | | | | |
| **HF commutating reactor**<br>Order No.: | | | | | | | |
| **6SN11 11-0AA00-** | | – | **-0BA1** | **-0CA1** | **-0DA1** | **-1EA0** | **-1FA0** |
| **6SN11 11-1AA00-** | | **-0CA0** | – | – | – | – | – |

1) FL = Flat termination, 0.355 in (9 mm) hole diameter.

## Mains filters

Fig. 6/26
Mains filter for 16 kW

The mains filters limit the conducted interference emanating from converter units to the permissible EMC values for industrial environments.

Provided the installation is configured in accordance with the Planning Guide and the EMC guideline for SIMODRIVE, compliance with the limit values stipulated by the EU EMC Directive is ensured at the installation site.

Other functions of the mains filters in combination with the I/RF (aka. I/R) modules in sinusoidal current mode are:

- Provided the network short-circuit rating is adequate, the low-frequency mains harmonic voltages remain within the limits set down by the VDEW requirements.
- Damping of resonance circuits (resonance circuits that are formed from the largely unknown mains impedances and impedances of the drive system).
- No impairment of the ripple control frequency ranges.
- Low leakage current design for the use of universal current-sensitive residual-current protection devices with rated fault currents ≥300 mA.

A separate mains filter, such as the 6SN11 11-0AA01-1BA0, must be included in the supply cable in cases where there is a separate connection between the electronic power supply and the network (6-conductor connection).

When operating with rated mains voltages greater than 3 AC 415 V, a matching transformer must be connected in series with the mains filter.

## Technical specifications with ordering data

| Assignment to mains infeed module | HP (kW) | 6.5 (5) O/I (aka. U/E) | 13.5 (10) O/I (aka. U/E) | 38 (28) O/I (aka. U/E) | 22 (16) I/RF (aka. I/R) | 49 (36) I/RF (aka. I/R) | 75 (55) I/RF (aka. I/R) | 109 (80) I/RF (aka. I/R) | 160 (120) I/RF (aka. I/R) |
|---|---|---|---|---|---|---|---|---|---|
| **Rated AC** | **A** | 16 | 25 | 65 | 30 | 67 | 103 | 150 | 225 |
| **Power loss** | **W** | 20 | 20 | 25 | 70 | 90 | 110 | 150 | 200 |
| **Max. conductor cross-section** | **mm²**<br>**AWG** | 4<br>12 | 10<br>8 | 50<br>1 | 10<br>8 | 50<br>1 | 50<br>1 | 95<br>310 | FL[1] |
| **Equipotential connection** | **GND (PE)** | M6, stud | M6, stud | M10, stud | M5, stud | M8, stud | M8, stud | M8, stud | M10, stud |
| **Weight, approx.** | **lb (kg)** | 8.36 (3.8) | 12.54 (5.7) | 27.5 (12.5) | 19.8 (9) | 35.2 (16) | 41.8 (19) | 48.4 (22) | 70.4 (32) |
| **Dimensions (W x H x D) approx.** | **in (mm)** | 6.08 x 7.52 x 3.15 (156 x 193 x 81) | 6.08 x 10.95 x 3.54 (156 x 281 x 91) | 6.66 x 10.17 x 5.49 (171 x 261 x 141) | 5.07 x 18.72 x 5.83 (130 x 480 x 149.5) | 5.07 x 18.72 x 9.53 (130 x 480 x 244.5) | 5.07 x 18.72 x 10.90 (130 x 480 x 279.5) | 7.8 x 18.72 x 10.90 (200 x 480 x 279.5) | 11.7 x 18.72 x 10.90 (300 x 480 x 279.5) |
| **Supply voltage** | **V** | 400 3-phase AC ±10% or 415 3-phase AC +10% (TN[2]) network) | | | | | | | |
| **Frequency** | **Hz** | 50/60 ±10% | | | | | | | |
| **Degree of protection** | | IP 20 according to IEC 60 529 (DIN EN 60 529) | | | | | | | |
| **Humidity classification according to DIN EN 60 721-3-3** | | Cl. 3K5, condensation and icing excluded.<br>Low air temperature: +32 °F (0 °C) | | | | | | | |
| **Permissible ambient temperature**<br>• **Operation**<br>• **Storage and transport** | **°F (°C)**<br>**°F (°C)** | +32 to +104 (0 to +40), up to 131 (+55) with 0.6 x $P_{rated}$ of the OI or I/RF module<br>–13 to +158 (–25 to +70) | | | | | | | |
| **Installation altitude** | **m** | 800, with derating up to 2000 above sea level | | | | | | | |
| **Interference suppression** | | according to EN 55 011, conducted limit class A if configured according to the Planning Guide | | | | | | | |
| **Mains filter for OI modules** Order No.: | | | | | | | | | |
| **6SN11 11-0AA01-** | | **-1BA0** | **-1AA0** | **-1CA0** | – | – | – | – | – |
| **Mains filter for I/RF modules** Order No.: | | | | | | | | | |
| **6SN11 11-0AA01-** | | – | – | – | **-2BA0** | **-2CA0** | **-2DA0** | **-2EA0** | **-2FA0** |

1) FL = Flat termination, 0.355 in (9 mm) hole diameter.

2) TN = Grounded system.

## Mains filter package

Mains filter packages are available for the I/RF (aka. I/R) modules. These mains filter packages consist of a mains filter and an HF commutation reactor which are supplied, packed separately, as a package. For technical specifications see HF commutation reactor and main filters.

Adapter sets are available to adapt the mains filter packages to the assembly surface of the filter modules. The mounted depth juts out of the front plane of the drive group by 0.788 in (20 mm) to 1.182 in (30 mm).

### *Ordering data*

| Assignment to I/RF (aka. I/R) module | Order No. | 22 HP (16 kW) | 49 HP (36 kW) | 75 HP (55 kW) | 109 HP (80 kW) | 160 HP (120 kW) |
|---|---|---|---|---|---|---|
| **Mains filter package** | **6SN11 11-0AA01-** | **-2BB0** | **-2CB0** | **-2DB0** | **-2EB0** | **-2FB0** |
| **Adapter set**<br>for mains filter and HF commutation reactor | **6SN11 62-0GA00-** | **-0BA0** | **-0CA0** | **-0DA0** | **-0EA0** | **-0EA0** |

## Overvoltage limiter module

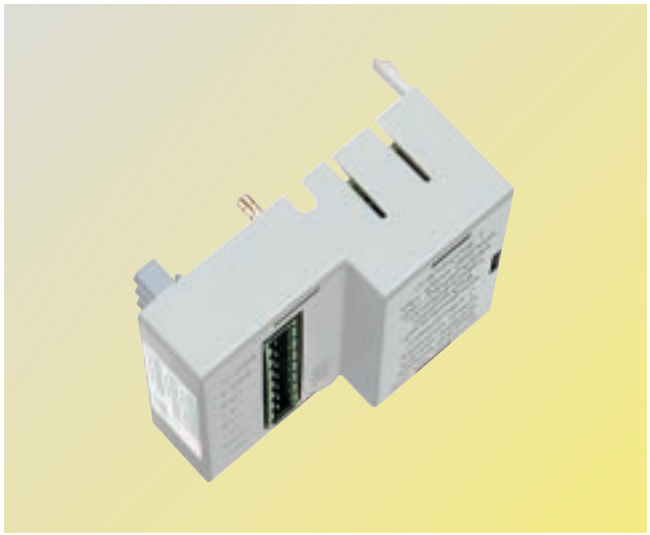


Fig. 6/27
Overvoltage limiter module

The overvoltage limiter module limits the overvoltages that occur as the result of, for example, switching operations on inductive consumers and on network matching transformers to values acceptable for the mains infeed modules above 10 kW (3.940 in [100 mm] width). It is inserted at interface X181.

The overvoltage limiter module is used for upstream transformers or networks that do not meet IEC requirements.

**For UL compliance of the mains infeed module the overvoltage limiter module must be used.**

An appropriate protective circuit is integrated as standard in the 5 kW OI module.

### *Technical specifications*

| | |
|---|---|
| **Maximum energy absorption** | 100 joule |
| **Approximate weight** | 10.6 oz (0.3 kg) |
| **Dimensions (H x W x D)** | 2.994 in (76 mm) x 2.758 in (70 mm) x 1.280 in (32.5 mm) |
| **Maximum module depth in installed state** | 12.805 in (325 mm) |

### *Ordering data*

| | Order No. |
|---|---|
| **Overvoltage limiter module**<br>for mains infeed modules above 10 kW<br>for SIMODRIVE 611 | **6SN11 11-0AB00-0AA0** |

## Regulated infeed/regenerative feedback I/RF (aka. I/R) modules

Fig. 6/28
36 kW I/RF (aka. I/R) module, internal cooling

The infeed modules are used to connect the drive group to the electricity supply system. The infeed modules take the 400 V AC 3-phase ±10% 50 Hz/60 Hz, 415 V AC 3-phase ±10% 50 Hz/60 Hz or 480 V AC 3-phase +6% – 10 % 50 Hz/60 Hz mains voltage to form the direct voltage for the DC link. In addition, the electronics voltages (±24 V, ±15 V, ±5 V, etc.) are made available to the drive modules centrally by means of the device/unit bus.

A transformer is required if the infeed modules are connected to a network that deviates from the TN form or a network without direct-current-sensitive residual-current devices. The HF commutation reactor is also required for the regulated infeed/regenerative feedback module.

An appropriate transformer for voltage matching is also required for network voltages 200 V/220 V/240 V/440 V/500 V/575 V AC 3-phase ±10 % 50 Hz/60 Hz.

The required cooling components, such as separate fan and/or air baffles to carry air to the module heat sinks, are included in the scope of supply for modules with width ≤7.880 in (200 mm) for both the internally and externally cooled versions. Please observe the appropriate notes for the 11.820 in (300 mm) modules.

Optional shield terminal plates are available to meet EMC requirements for wiring with shielded power cables.

For UL compliance of the mains infeed modules, the overvoltage limiter module must be used.

### *Application*

- Machines that place high dynamic demands on the drives
- Frequent braking cycles and high braking energies
- Switching cabinet design optimized for low operating costs

When the regulated control infeed/regenerative feedback modules are used, it is possible to feed excess DC link energy generated when braking, for example, back into the supply system. This results in optimization of the switching cabinet cooling and thus allows the operator to cut energy costs. The drive axes operate at a constant DC link voltage.

The matching HF commutation reactor indicated in the selection table is required for connection to the mains power supply.

The associated mains filter package must be used to comply with the EU EMC Directive.

### *Integrated functions*

The functions integrated in the infeed modules and I/RF modules reduce the external wiring of the drive systems:

- Using the input terminal (24 V) to activate the integrated line contactor.
- The external interlock input can be used to interrupt the energy supply of the contactor coil using hardware contacts for electrical isolation from the line contactor.
- Automatic DC link precharging on connection to the network.
- Maintain the electronics power supply from the DC link energy to bring the coupled drive axes to a controlled stop should the power fail. A pulsed resistor module is required to ensure that braking is also possible in this operating status.
- Central monitoring of the mains voltage, DC link voltage and electronic voltages ±24 V, ±15 V, +5 V.
- Coding switches can be used to select the various operating functions for the I/RF modules:
  - Regulated control with link voltage of 600 V DC or 625 V DC with sinusoidal current loading on network with cosλ ≥ 0.97 (status upon delivery). The power factor cosλ takes into account the sum of all of the mains harmonic voltages
  - Regulated control with link voltage of 600 V DC or 625 V DC with block current loading on the network
  - Unregulated control with link voltage of 490 V DC (400 V in the case of 3-phase AC) with and without regenerative feedback to the system
  - Direct operation on 480 V AC 3-phase +6% – 10% TN systems; 50 Hz/60 Hz with open-loop control link voltage of 680 V DC with regenerative feedback.

## Unregulated control/infeed O/I (aka. U/E) module, non-regenerative

Fig. 6/29
10 kW O/I (aka. U/E) module, internal/external cooling

***Application***

- Machines with few or short braking cycles, low braking energy
- Operation on networks from $SK_{mains}/P_{nOI} \geq 30$

  $SK$ Mains short-circuit power

  $P_{nOI}$ Rated power of OI module
- Drive groups with limited dynamic demands.

Unregulated control infeed modules are available for low outputs. These modules up to 10 kW contain the commutation reactor and a pulsed resistor which converts the braking energy of the drive modules into heat. With maximum capacity utilization of the pulsed resistor (>200 W), a thermally conductive cover (No. 6SN11 62-0BA01-0AA0) must be used in order to keep the heat away from the modules located above.

The commutation reactor and the pulsed resistors must be separately ordered and installed for the 28 kW OI module. The OI module contains the control for the pulsed resistors.

## Power modules

Fig. 6/30
Power module internal cooling with internal fan, module width 3.940 in (100 mm)

The power modules are designed to operate the following:

- 1FT6 and 1FK6 servomotors
- 1FN linear motors
- 1PH4, 1PH6, 1PH7 and 1FE1 motors
- Standard 1LA induction motors

A wide range of 1-axis or 2-axis power modules is available. They are graded according to amperage and can be supplied with three different cooling techniques.

The current data refer to the series-preset values. Reductions must be made for higher frequencies of first harmonic or higher pulse frequencies (see Section 6.)

Matching, pre-assembled power cables are available for connecting the motors. Please refer to the General motion Control Catalog Part 2.

Shield terminal plates are available to meet EMC requirements for wiring with shielded power cables.

The unit bus cable is included in the scope of supply of the power module.

## Closed-loop control plug-in units with analog setpoint interface

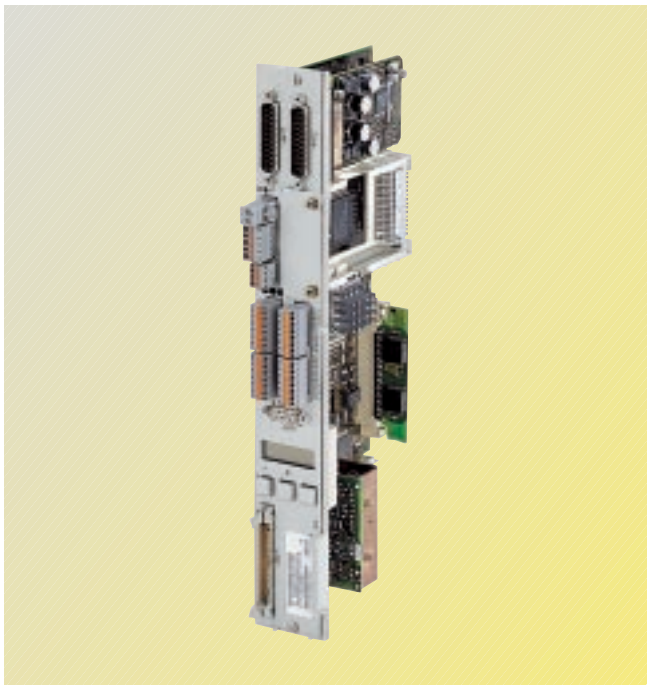


Fig. 6/31
SIMODRIVE 611 universal

SIMODRIVE 611 universal is a closed-loop control plug-in unit with analog speed setpoint interface and optional PROFIBUS-DP interface both with/without positioning functionality with motor frequencies of up to 1400 Hz for:

- 1FT6, 1FK6, 1FE1 synchronous motors
- 1FN linear motors
- 1PH, 1LA5 induction motors with/without encoder

Both 1-axis and 2-axis closed-loop control plug-in units can be ordered with options. The 2-axis versions can also be used in the 1-axis power modules.

The following encoder evaluations are available for various closed-loop control plug-in units:

- Resolver
  2 to 6 pairs of poles; up to 375 Hz, pulse multiplication factor internal 4096 x number of pairs of poles of the resolver
- Encoder with sin/cos 1 $V_{pp}$
  0 to 65535 signals/revolution, max. 350 kHz pulse multiplication factor internal 128 x signals/revolution
- Absolute value encoder with EnDat interface same as encoder sin/cos 1 $V_{pp}$ plus EnDat evaluation for position signal

Variants: for closed-loop control plug-in units and options, see Ordering data.

The drive can be started either by means of a 7-segment display and keyboard on the front of the module or by means of the SimoCom U installation tool run on a PC under Windows NT/95/98.

### *Functions (selection)*

- Analog rotary setpoint interface
- Incremental shaft-angle encoder interface WSG
  To convey actual positions in the form of a pulse directional signal to a higher-level control
- Encoder pulse simulation, tracks A, B and R; ±5 V TTL (RS 485, RS 422) can be connected with 1024 signals/revolution with resolver. The number of pulses can be divided with resolver: 1:2, 1:4, 1:8. 0 to 65535 signals/revolution with sin/cos 1 $V_{pp}$ encoder 1:1 S/R
- Four each of digital inputs and outputs, user-parameterizable
- RS232/RS485 interface for connection to a PC/PG
- Four motor data blocks can be stored per axis, star/delta changeover possible
- Positioning
  Absolute, relative, rotary axis, external block change, jerk limitation; block relaying with:
  CONTINUE WITH ON-THE-FLY,
  CONTINUE WITH STOP,
  GO TO,
  END
  64 data blocks per axis can be stored and edited as parameters. They can be called up and edited by means of the PROFIBUS option. 64 blocks can be called up by means of the terminal extension option for axis A.

## Monitoring module

Fig. 6/32
Monitoring module, internal/external cooling

The monitoring module contains a complete electronics power supply and the central monitoring functions for a self-contained drive group. The power supply can be taken from either the 400 V to 480 V 3-phase AC mains or from the DC link voltage.

The monitoring module must be installed when a large number of drive modules in a drive grouping require more electronic power than the infeed module can supply (see assessment and configuration sheet example).

The monitoring module allows drive modules located in several different cabinet panels or tiers to be formed into groups.

### *Technical specifications*

| | |
|---|---|
| **Rated supply voltage** | 400 V AC 3-phase – 10% to 480 V AC 3-phase +6%<br>50 Hz to 60 Hz ±10%<br>or<br>490 V to 680 V DC |
| **Power loss** | 70 W |
| **Cooling type** | Natural cooling |
| **Weight, approx.** | 11 lb (5 kg) |
| **Module width** | 1.970 in (50 mm) |

### *Ordering data*

| | Order No. |
|---|---|
| **Monitoring module for SIMODRIVE 611**<br>Complete with all termination and connection elements suitable for internal and external cooling | **6SN11 12-1AC01-0AA1** |
| **Blanking plate**<br>for mounting the module and covering the prepared opening for the external cooling<br>Width: 1.970 in (50 mm) | **6SN11 62-0BA04-0JA0** |

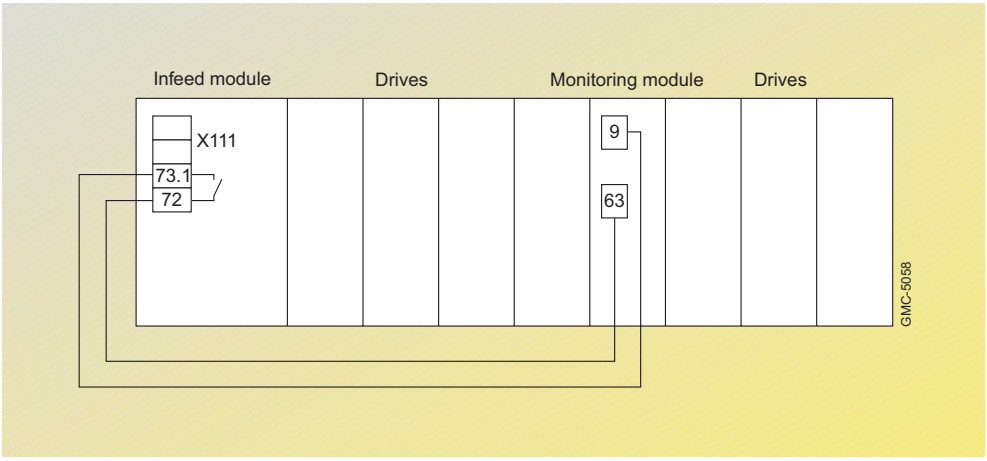



Fig. 6/33
Connecting diagram

If a monitoring module is integrated in the system, terminal 63 on the monitoring module must be looped through via the ready-relay terminal 72 – terminal 73.1 (NO contact) of the infeed module.

The ready relay of the infeed module must be set to ready (S1.2 OFF setting).

## Pulsed resistor

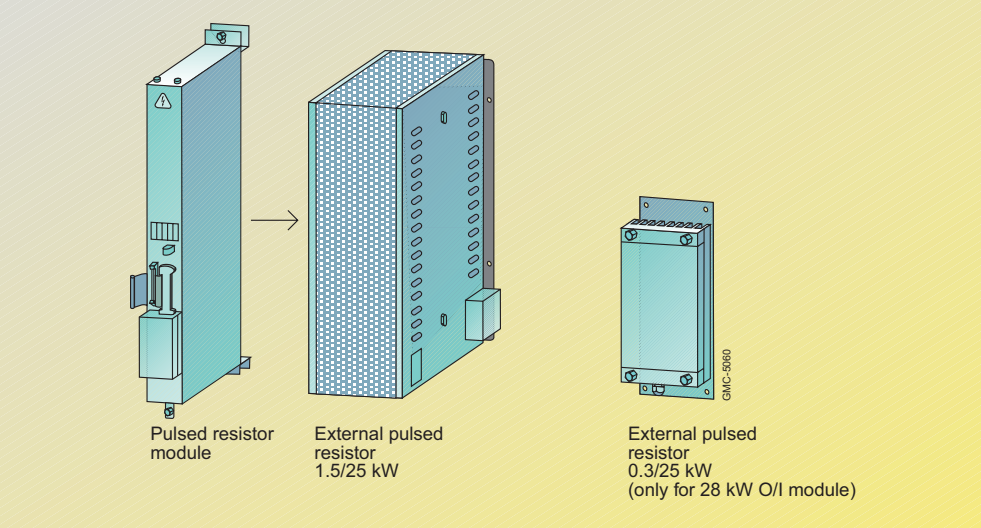

Pulsed resistor module
External pulsed resistor 1.5/25 kW
External pulsed resistor 0.3/25 kW (only for 28 kW O/I module)
GMC-5060

Fig. 6/34
Pulsed resistor module and external pulsed resistor

The pulsed resistor module can be used to effect rapid discharge of the DC link. Several pulsed resistor modules can be connected in parallel. Other possible applications are increasing the pulsed resistor rating in conjunction with the open-loop[1]) (aka. U/E) control infeed module or reducing the DC link voltage in the event of controlled braking processes after mains failure.

In the case of maximum utilization of the internal pulse resistance >200 W, the use of a thermally conductive cover is recommended to hold the heat back from the modules above.

### *External pulsed resistors*

The external pulsed resistors can be used to transfer the heat loss to outside the switching cabinet. The external pulsed resistors are always required for the 28 kW O/I module.

Depending on the power requirement, the 0.3/25 kW and 1.5 kW/25 kW pulsed resistors can be mixed in the 28 kW O/I module. The protection function is parameterized via the connecting terminals.

It is not possible to connect the 0.3 kW/25 kW external resistor to the pulsed resistor module.

Shielded cables should be used for connections with pulsed resistors.

For sizing of braking unit and resistor, see calculating example.

### *Technical Data*

| | External pulsed resistor 0.3/25 kW | External pulsed resistor 1.5/25 kW | Internal pulsed resistor 0.3/25 kW | Internal pulsed resistor 0.2/10 kW |
|---|---|---|---|---|
| **Order No., pulsed resistor** | 6SN11 13-1AA00-0DA0 | 6SN11 13-1AA00-0CA0 | – | – |
| **Integrated in** | – | – | O/I 13.5 HP (10 kW), pulsed resistor module | O/I 6.5 HP (5 kW) |
| **Can be used for** | O/I module 38 HP (28 kW) | O/I module 38 HP (28 kW) | – | – |
| **Can be used for** | – | Pulsed resistor module 6SN11 13-1AB0□-0BA□ | – | – |
| $P_n$ | 0.3 kW | 1.5 kW | 0.3 kW | 0.2 kW |
| $P_{max}$ | 25 kW | 25 kW | 25 kW | 10 kW |
| $E_{max}$ | 7.5 kWs | 180 kWs | 7.5 kWs | 13.5 kWs |
| **Degree of protection** | IP 54 | IP 20 | refer to module | refer to module |

Dimension drawings, refer to Section 7

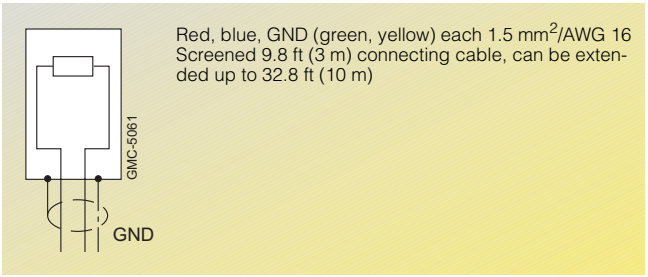
### *Ordering Data*

| | Order No. |
|---|---|
| **Pulsed resistor module for SIMODRIVE 611** Complete with all termination and connection elements | **6SN11 13-1AB01-0BA1** |
| **Blanking plate** for mounting the module and to cover the prepared opening for the external cooling Width: 1.970 in (50 mm) | **6SN11 62-0BA04-0JA0** |
| **External pulsed resistor** 1.5 kW/25 kW | **6SN11 13-1AA00-0CA0** |
| **External pulsed resistor** 0.3 kW/25 kW only for 28 kW O/I module | **6SN11 13-1AA00-0DA0** |
| **Thermally conductive cover** | **6SN11 62-0BA01-0AA0** |

1) Unregulated/non-regenerative unit.

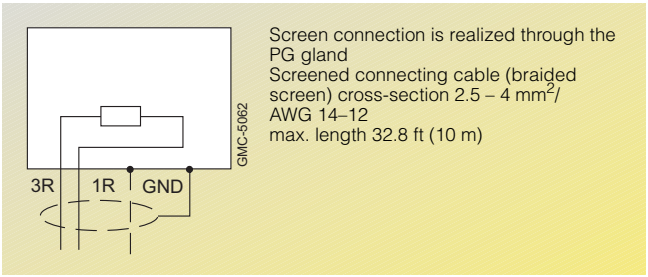
## Connecting of the external pulsed resistors

Horizontal and vertical mounting positions are possible




Red, blue, GND (green, yellow) each 1.5 mm$^2$/AWG 16
Screened 9.8 ft (3 m) connecting cable, can be extended up to 32.8 ft (10 m)

Fig. 6/35
Connection for an external pulsed resistor 0.3/25 kW
Order No.: 6SN11 13-1AA00-0DA00

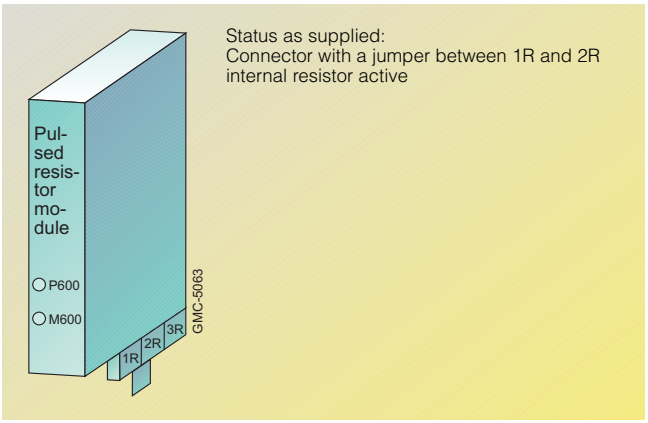



Screen connection is realized through the PG gland
Screened connecting cable (braided screen) cross-section 2.5 – 4 mm$^2$/ AWG 14–12
max. length 32.8 ft (10 m)

Fig. 6/36
Connection for an external pulsed resistor 1.5/25 kW
Order No.: 6SN11 13-1AA00-0CA00

**Note:**
Conductors which are not used in multi-conductor cables must always be connected to GND at both ends.

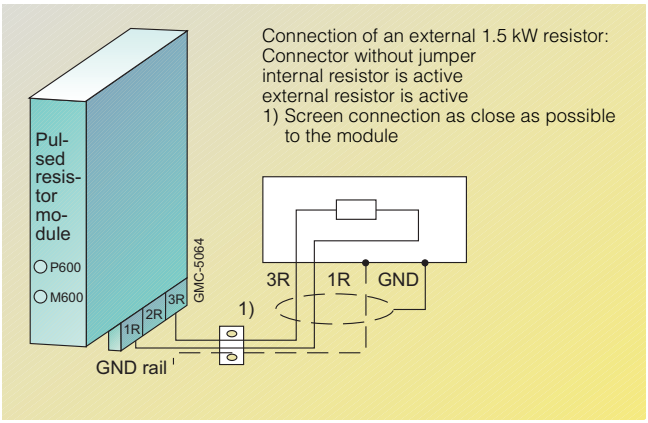
## Connection types for pulsed resistor modules




Status as supplied:
Connector with a jumper between 1R and 2R
internal resistor active

Fig. 6/37
Status of the pulsed resistor module when supplied
Order No.: 6SN11 13-1AB0□-0□A□

**Note:**
For the pulsed resistor modules, only the external 1.5/25 kW pulsed resistor can be connected.




Connection of an external 1.5 kW resistor:
Connector without jumper
internal resistor is active
external resistor is active
1) Screen connection as close as possible to the module

Fig. 6/38
Connection of an external 1.5 kW pulsed resistor module
Order No.: 6SN11 13-1AB0□-0□A□

No. of pulsed resistor modules connected to the same DC link, refer to calculating example.

$N \leq C/500\ \mu F$

N Max. number of pulsed resistor modules (must always be rounded-off)

C DC link capacitance of the drive group in $\mu F$

## Possibilities of connecting external pulsed resistors to the 28 kW module

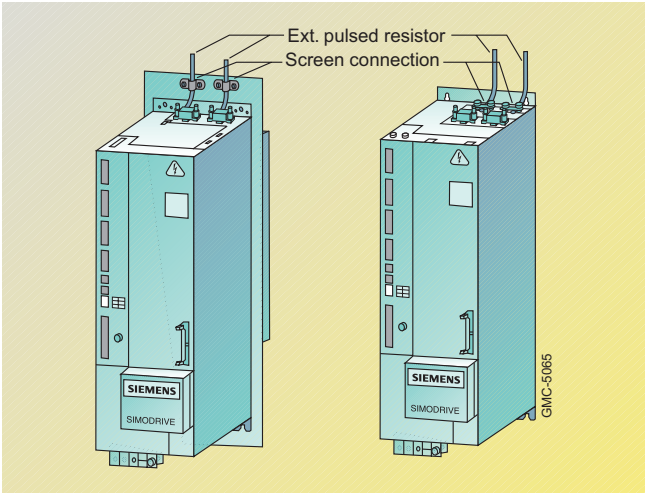



Fig. 6/39
Connecting an external pulsed resistor with screen connection

| Pulsed resistor (PR) | Terminal block TR1 | Terminal block TR2 |
|---|---|---|
| 0.3/25 kW | 1R 2R 3R — * — PR 0.3 kW | 1R 2R 3R |
| 2 x 0.3/25 kW = 0.6/50 kW | 1R 2R 3R — * — PR 0.3 kW | 1R 2R 3R — * — PR 0.3 kW |
| 1.5/25 kW | 1R 2R 3R — PR 1.5 kW | 1R 2R 3R |
| 2 x 1.5/25 kW = 3/50 kW | 1R 2R 3R — PR 1.5 kW | 1R 2R 3R — PR 1.5 kW |

Permissible methods of connecting an external pulsed resistor to O/I (aka. U/E) 28 kW

* Jumper to code the thermal limiting characteristic

**Note:**
The 28 kW O/I module does not include a pulsed resistor.
However, the braking chopper is built in.

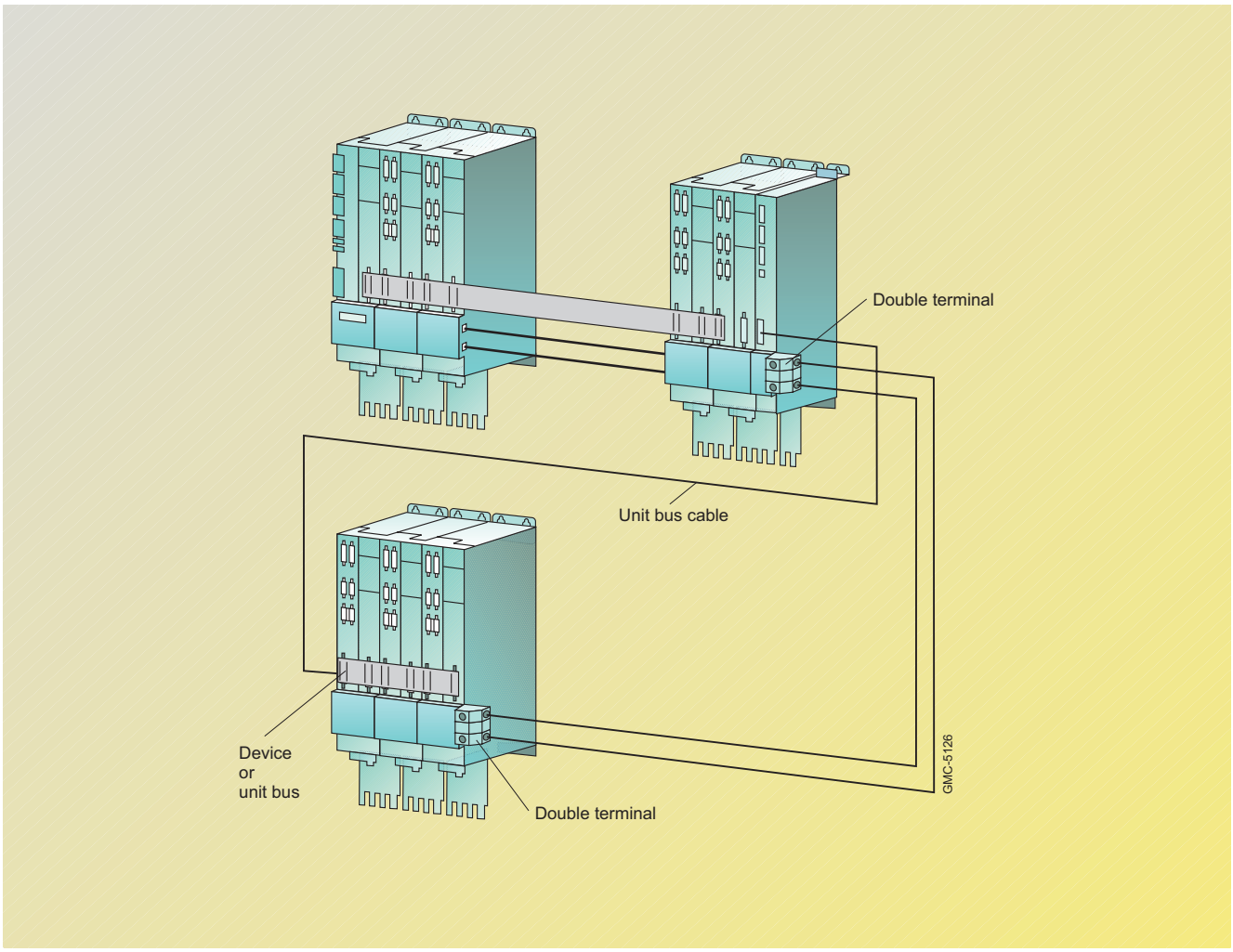



Fig. 6/40

1. From the in feed module equipment bus output, the maximum equipment bus length may be 6.9 ft (2.1 m).
2. DC link connection with parallel cables for subsequently connected modules, 11.8 in (300 mm) wide Cu AWG 20 (70 $mm^2$) for subsequently connected modules < 11.8 in (< 300 mm) Cu AWG 1 (50 $mm^2$).
   The cable must be routed so that it is short-circuit/ground-fault proof. Further, a potential bonding conductor must be provided which is connected to both modules (at the thread for the screen plate connection).
3. Equipment bus extension, 4 ft 11 in (1.5 m).

## Ordering data

| | Order No. |
|---|---|
| **Adapter terminals for DC link connection**<br>(for 2-tier configuration)<br>• Package with two double-terminals 50 $mm^2$ for modules 1.970 in (50 mm) to 7.880 in (200 mm) wide | **6SN11 61-1AA01-0BA0** |
| • Package with two double-terminals 95 $mm^2$ for module 11.8 in (300 mm) wide | **6SN11 61-1AA01-0AA0** |
| **Unit bus cable**<br>(for 2-tier configuration)<br>with SIMODRIVE 611<br>Length: 4 ft 11 in (1.5 m) | **6SN11 61-1AA00-0AA1** |

## Internal cooling

In this standard solution, the power loss of the converter components from the electronic equipment and the power section is dissipated to the switching cabinet interior.

For the 80 kW and the 120 kW I/RF infeed module the built-on fan 6SN11 62-0BA02-0AA1 is required for the internal cooling.

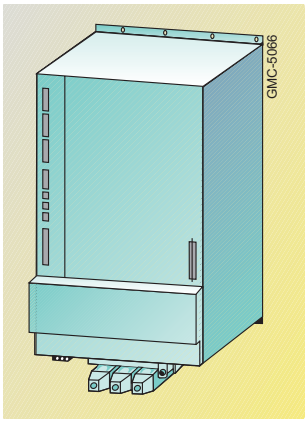



Fig. 6/41
Infeed module internal cooling

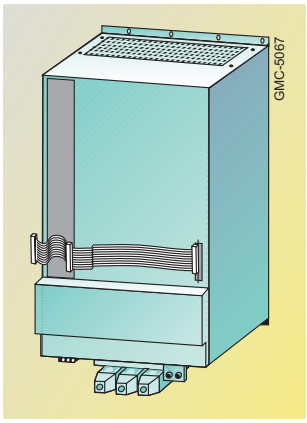



Fig. 6/42
Power module internal cooling

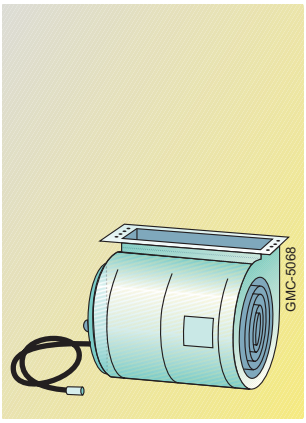
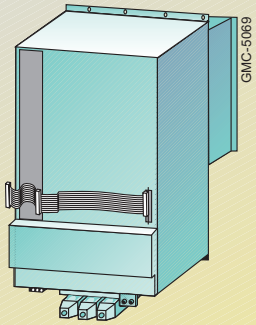



Fig. 6/43
Built-on fan 6SN11 62-0BA02-0AA1

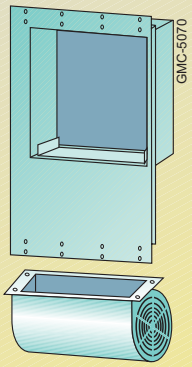
## External cooling

Because the heat sinks of the modules pass through the mounting surface in the switching cabinet, the power loss of the power section can be dissipated to an external ventilation circuit. Only the power loss of the electronic equipment remains in the switching cabinet. Degree of protection IP 54 can be attained at the "mechanical interface" which is the external heat sink.

- Ordering numbers see infeed and power modules for external cooling.
- When you use a monitoring module or a pulsed resistor module a blanking plate 6SN11 62-0AB04-0JA0 for mounting the module and covering the prepared opening can be ordered.



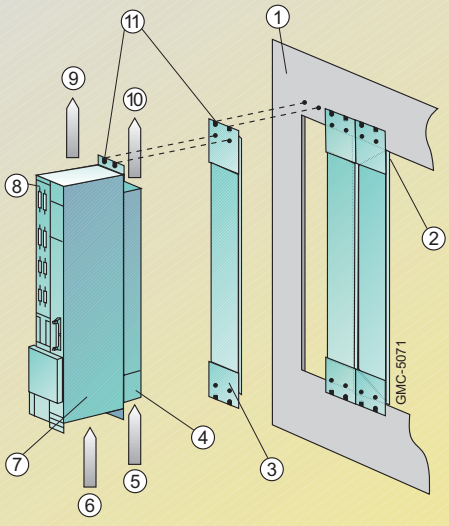

Power module




Mounting frame with built-on fan

For external cooling, the fan box is part of the scope of supply of the mounting frame for the 11.820 in (300 mm) module width. The required 6SN11 62-0BA02-0AA1 built-on fan must be ordered separately.

Fig. 6/44
Power module external cooling and mounting frame with built-on fan

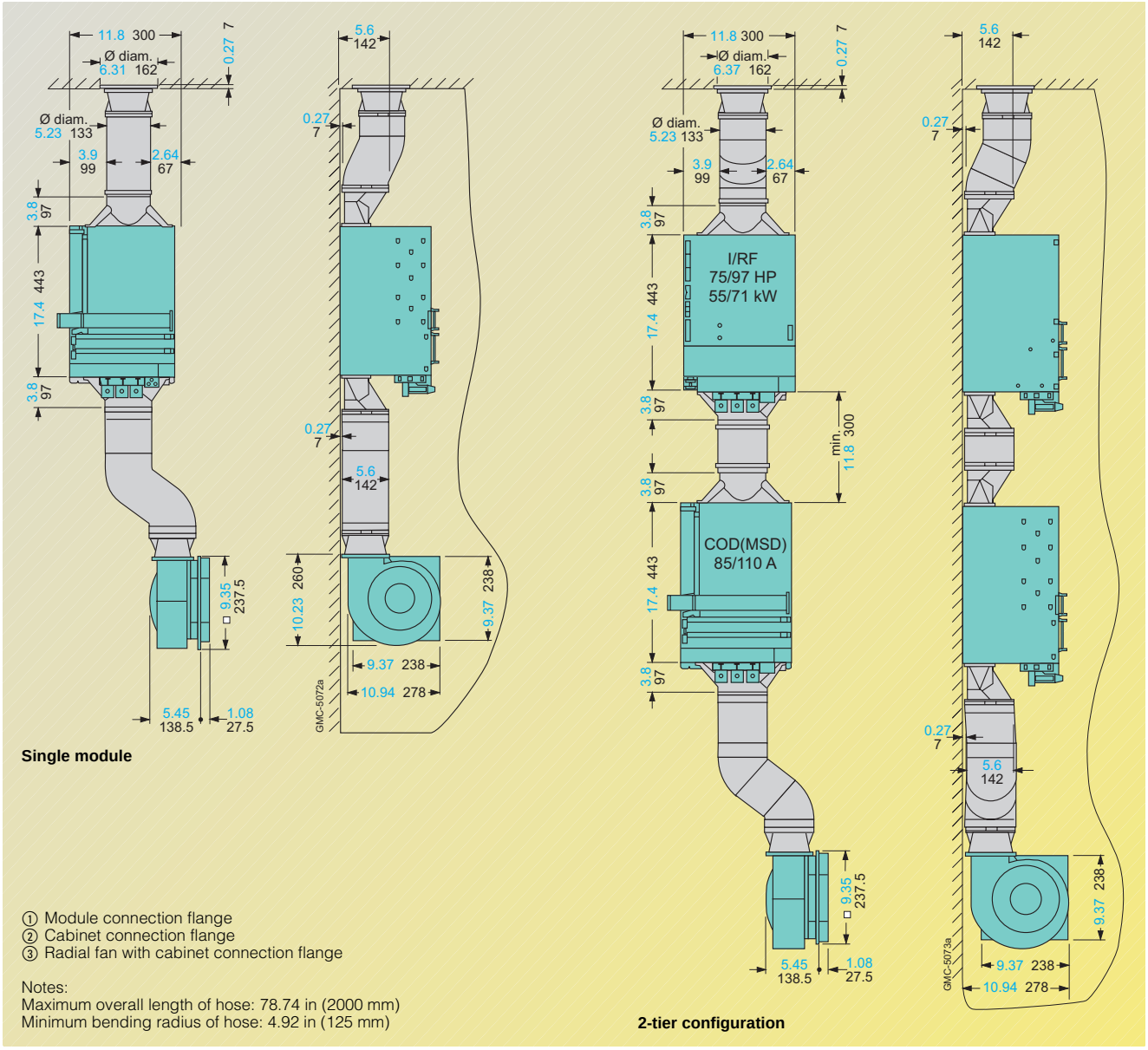



① Switching cabinet (untreated metal surface)
② Mounting frames sealed against each other and against the back of the switching cabinet (e.g. with Terostat-9 from Teroson company). The sealing agent should be applied continuously such that the degree of protection IP 51 is satisfied.
③ Mounting frame
④ Fan box
⑤ Supply air for heat sink $T^3$ 40°C
⑥ Supply air for electronics $T^3$ 40°C
⑦ Power module with external heat dissipation and heat sink sealing
⑧ Closed-loop control
⑨ Electronics exhaust air
⑩ Heat sink exhaust air
⑪ M5 screw, low-rotor torque 3 Nm

Fig. 6/45

## Hose cooling

Hose cooling is designed for switching cabinets that do not have a separate ventilation channel for the power sections. Flexible tubes are used to remove the power loss of the power sections from the cabinet. Degree of protection IP 54, NEMA 12 can be attained at the “mechanical interface”.




① Module connection flange
② Cabinet connection flange
③ Radial fan with cabinet connection flange

Notes:
Maximum overall length of hose: 78.74 in (2000 mm)
Minimum bending radius of hose: 4.92 in (125 mm)

Fig. 6/46
Hose (pipe) cooling for 11.8 in (300 mm) modules without shield terminal plates

### *Ordering data*

| | Order No. |
|---|---|
| **Hose cooling packages**<br>• **Package 1**<br>for single module consisting of<br>2 x module connection flange 6 ft 7 in (2000 mm) hose<br>1 x cabinet connection flange<br>1 x radial fan with cabinet connection flange<br>360 V to 457 V 3-phase AC; 47.5 Hz to 62.5 Hz<br>Connection current: 1 A to 1.2 A | **6SN11 62-0BA03-0AA1** |
| • **Package 2**<br>for 2-tier configuration of 55 kW I/RF and LT 85 A consisting of<br>4 x module connection flange 6 ft 7 in (2000 mm) hose<br>1 x cabinet connection flange<br>1 x radial fan like Package 1 | **6SN11 62-0BA03-0CA1** |

## Overload capability

### *Rated load duty cycles for infeed modules*

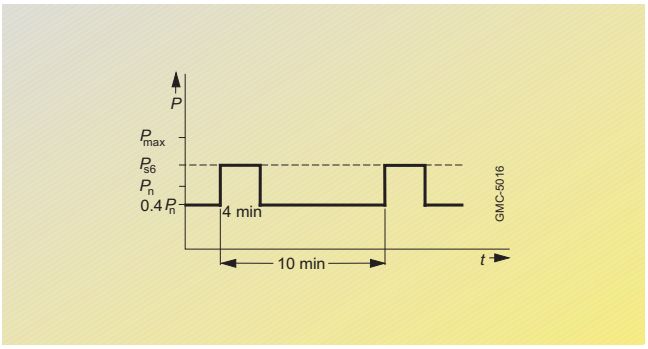



Fig. 6/47
S6 duty cycle with pre-loading condition

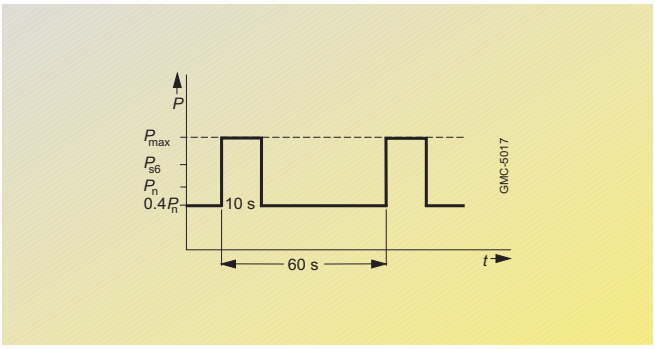



Fig. 6/48
Peak output duty cycle with pre-loading condition

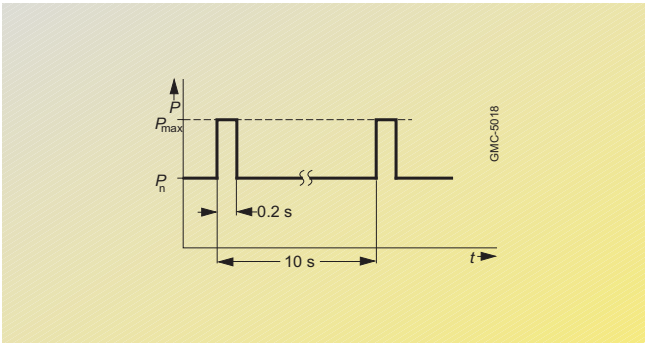
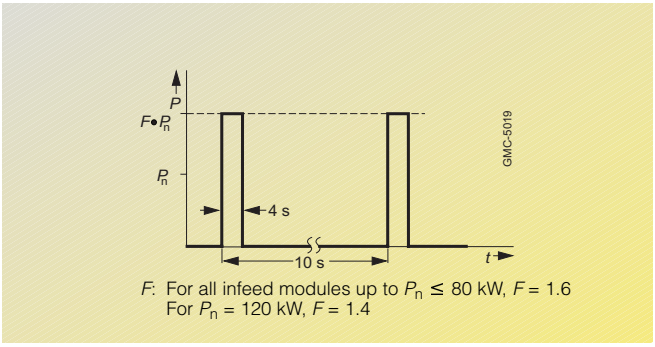



Fig. 6/49
Peak output duty cycle with pre-loading condition




*F*: For all infeed modules up to $P_n \leq 80$ kW, $F = 1.6$
For $P_n = 120$ kW, $F = 1.4$

Fig. 6/50
Peak output duty cycle without pre-loading condition

The following rule of thumb is valid:

$X = 1.03$ for $T \leq 10$ s
$X = 0.90$ for 10 s $< T \leq 1$ min
$X = 0.89$ for 1 min $< T \leq 10$ min
$T$ = Total cycle time

$$P_{Mot\ rms} > \sqrt{\frac{\sum\left(\frac{P_{Mot\ B} + P_{Mot\ E}}{2}\right)^2 \cdot \Delta t_i}{T}}$$

$P_{Mot\ B}$ = initial motor power in time increment $\Delta t_i$
$P_{Mot\ E}$ = final motor power in time increment $\Delta t_i$

### *De-rating as a function of the installation altitude*

All of the specified outputs are valid up to an installation altitude of 3281 ft (1000 m). For an installation altitude >3281 ft (1000 m) the specified outputs should be reduced according to the diagrams. For installation altitudes >6562 ft (2000 m) an isolating transformer must be used.

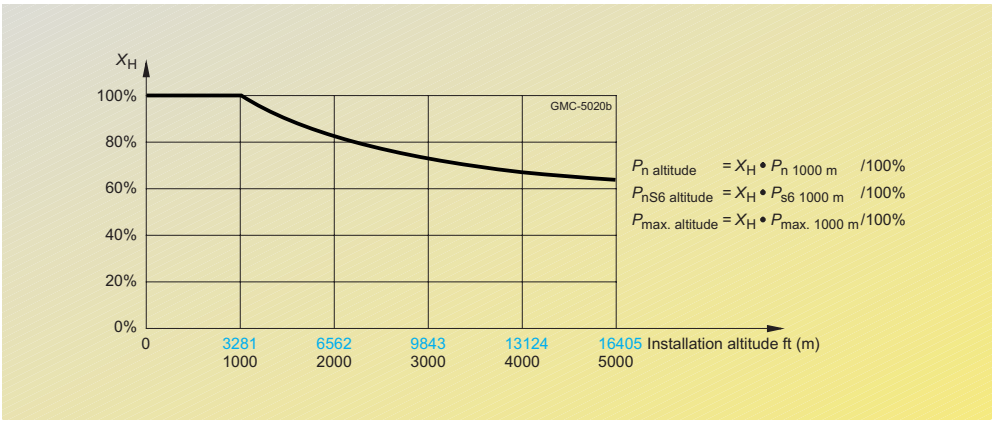



Fig. 6/51

**Caution: $P_n$, $P_{S6}$ and $P_{max.}$ must be de-rated in the same way.**

Example:
Infeed module I/RF 16 kW;
installation altitude 2000 m:
from Table: $X_H = 83$ %

→ $P_{n\ altitude} = X_H \cdot P_{n\ 1000\ m}/100\% = 83\% \cdot 16\ kW/100\% = 13.28\ kW$
→ $P_{n_{S6}\ altitude} = X_H \cdot P_{n_{S6}\ 1000\ m}/100\% = 83\% \cdot 21\ kW/100\% = 17.43\ kW$
→ $P_{max.\ altitude} = X_H \cdot P_{max.\ 1000\ m}/100\% = 83\% \cdot 35\ kW/100\% = 29.05\ kW$

## Overload capability

The power modules can be overloaded for a short time up to $I_{max.}$. The duration of the overload is dependent on the operating condition of the module. The necessary times are obtained from the overload diagrams.

### *Definition of the currents*

The sinusoidal currents are RMS values.

$I_n$ continuous current

$I_{s6}$ current for max. 4 min for S6 duty cycle

$I_{max.}$ peak current

### *Definition of the powers*

$Pv_{tot.}$ total module power loss

$Pv_{pipe}$ power loss which can be dissipated through pipe cooling

$Pv_{ext}$ power loss which can be dissipated through external cooling

$Pv_{int}$ power loss which is not dissipated via pipe or external cooling

This power loss remains in the cabinet.

### *Rated load duty cycles*

Typical of synchronous servomotors

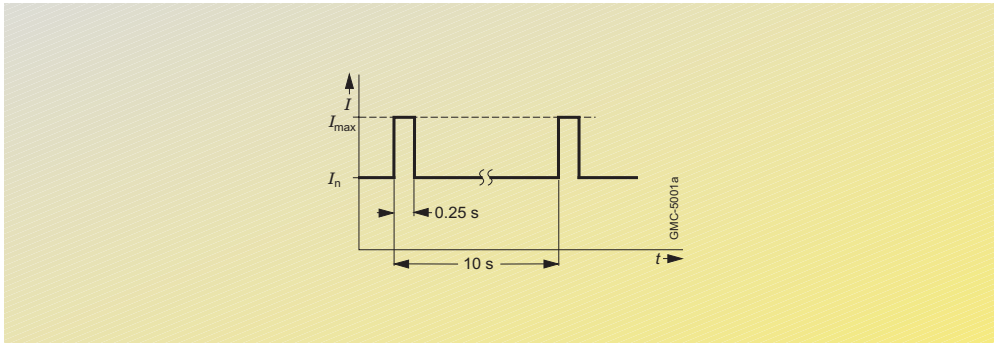



Fig. 6/52
Peak current – load duty cycle with pre-loading condition

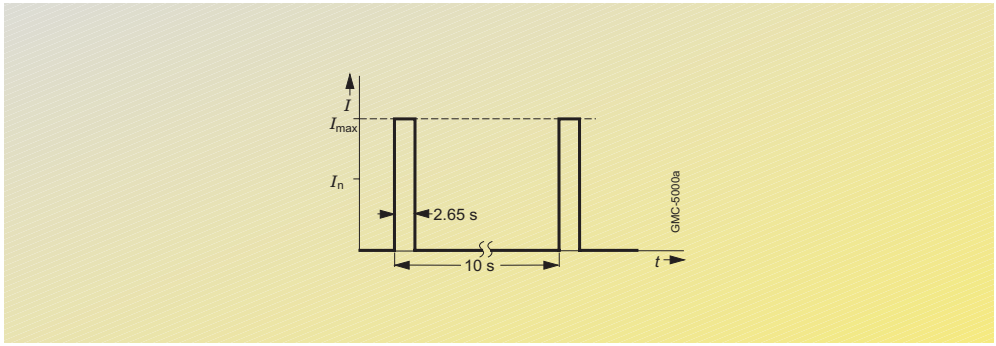



Fig. 6/53
Peak current – load duty cycle without pre-loading condition

Typical of asynchronous servomotors

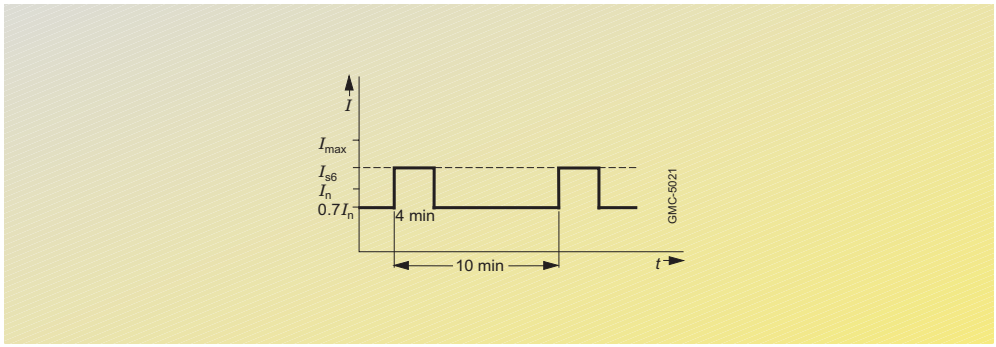



Fig. 6/54
S6 load duty cycle with pre-loading condition

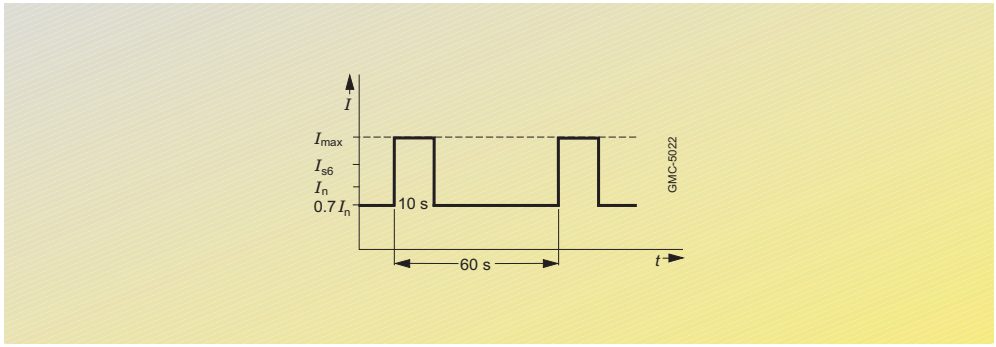



Fig. 6/55
S6 peak current-load duty cycle with pre-loading condition

## Current reduction curves

### Current reduction dependent on the inverter clock frequency

$X1$ = Current reduction factor, current reduction from the inverter clock frequency $f_0$ of the power transistors (refer to the technical data).

$$X = 100\% - \frac{(100\% - X1) \cdot (f_T - f_0)}{8\ \text{kHz} - f_0}$$

$X$ = the reduction factor obtained [in %] for $I_n$, $I_{s6}$, $I_{max.}$
$f_T$ = selected inverter clock frequency

**Caution:**
**The currents $I_n$, $I_{S6}$ and $I_{max.}$ must be reduced in the same way.**

→ $I_{n_{fT}} = X \cdot I_{n_{f0}}/100\%$
→ $I_{s6fT} = X \cdot I_{s6f0}/100\%$
→ $I_{max.fT} = X \cdot I_{max.f0}/100\%$

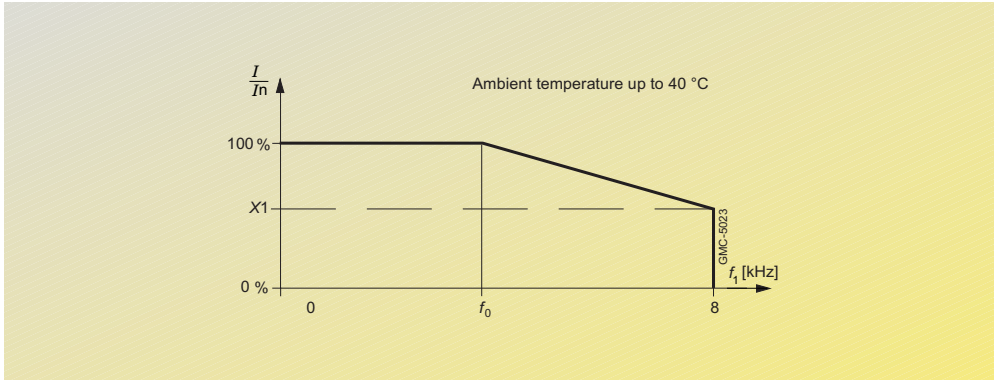



Fig. 6/56

### *Current reduction factors X1*

| Power module | $I_n/I_{max}$ induction motors | Clock frequency $f_0$ in kHz | Current reduction factor $X1$ in % for induction motors | $I_n/I_{max}$ synchronous motors | Clock frequency $f_0$ in kHz | Current reduction factor $X1$ in % for synchronous motors |
|---|---|---|---|---|---|---|
| 8 A | 3/3 A | 3.2 | 50 | 3/6 A | 4 | 55 |
| 15 A | 5/8 A | 3.2 | 50 | 5/10 A | 4 | 55 |
| 25 A | 8/16 A | 3.2 | 55 | 9/18 A | 4 | 55 |
| 50 A | 24/32 A | 3.2 | 40 | 18/36 A | 4 | 40 |
| 2 x 8 A | 2 x 3/3 A | | | 2 x 3/6 A | 4 | 55 |
| 2 x 15 A | 2 x 5/8 A | | | 2 x 5/10 A | 4 | 55 |
| 2 x 25 A | 2 x 8/16 A | | | 2 x 9/18 A | 4 | 55 |
| 2 x 50 A | | | | 2 x 18/36 A | 4 | 40 |
| 80 A | 30/51 A | 3.2 | 55 | 28/56 A | 4 | 50 |
| 108 A | 46/76 A | 3.2 | 55 | | | |
| 160 A | 60/102 A | 3.2 | 50 | 56/112 A | 4 | 55 |
| 200 A | 85/127 A | 3.2 | 55 | 70/140 A | 4 | 55 |
| 300 A | 120/193 A | 3.2 | 50 | | | |
| 400 A | 200/257 A | 3.2 | 50 | 140/210 A | 4 | 50 |

### Current reduction as a function of the installation altitude

All of the specified load currents are valid up to 3281 ft (1000 m) installation altitudes.
For installation altitude > 3281 ft (1000 m), the load currents must be de-rated according to the diagram below.

**Caution:**
**The currents $I_n$, $I_{S6}$ and $I_{max.}$ must be reduced in the same way.**

→ $I_{n\ alt.} = X_H \cdot I_{n\ 1000\ m}/100\%$
→ $I_{S6\ alt.} = X_H \cdot I_{s6\ 1000\ m}/100\%$
→ $I_{max.\ alt.} = X_H \cdot I_{max.1000m}/100\%$

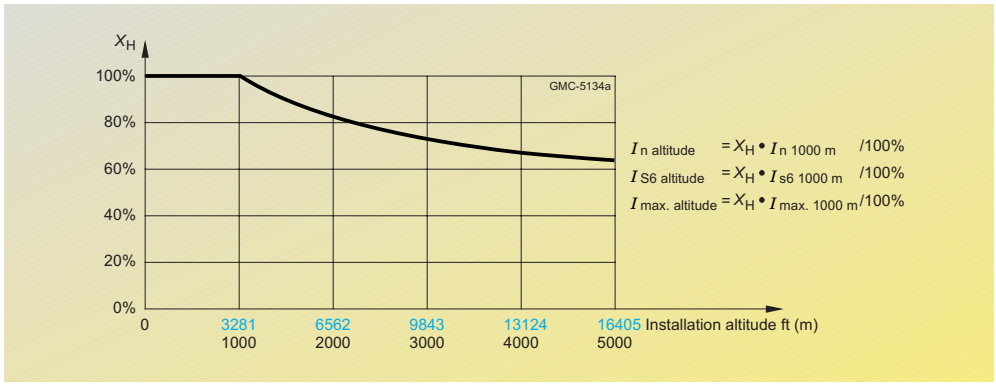



Fig. 6/57

Example:
PM (power module) 50 A: selected inverter clock frequencies 6.3 kHz; installation altitude 2000 m.

$$X = 100\% - \frac{(100\% - 40\%) \cdot (6.3\ \text{kHz} - 3.2\ \text{kHz})}{8\ \text{kHz} - 3.2\ \text{kHz}} = 61.25\%;\ X_H = 83\%$$

→ $I_{n\ 6.3\ kHz,\ 2000\ m} = (X \cdot I_{n\ f0}/100\%) \cdot X_H/100\% = 12\ A$
→ $I_{S6\ 6.3\ kHz,\ 2000\ m} = (X \cdot I_{s6\ f0}/100\%) \cdot X_H/100\% = 16\ A$
→ $I_{max.\ 6.3\ kHz,\ 2000\ m} = (X \cdot I_{max.\ f0}/100\%) \cdot X_H/100\% = 16\ A$

Permissible currents of the SIMODRIVE power modules for induction motors and drive applications (various S6 load duty cycles, defined, e.g. S6-25% → 2.5 min/7.5 min).

## O/I modules[1]) w/line filter

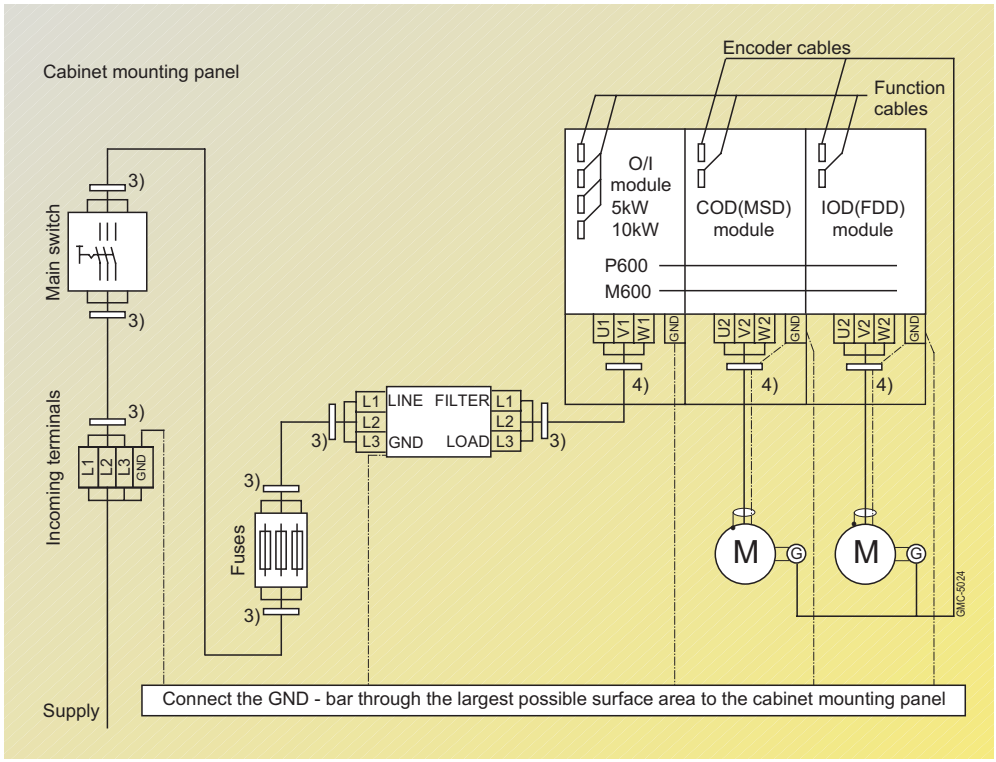



Fig. 6/58
Connecting diagram for line filters for 5 kW and 10 kW O/I modules

## O/I module[1]) 28 kW and I/RF (aka. I/R) modules[2]) w/line filter

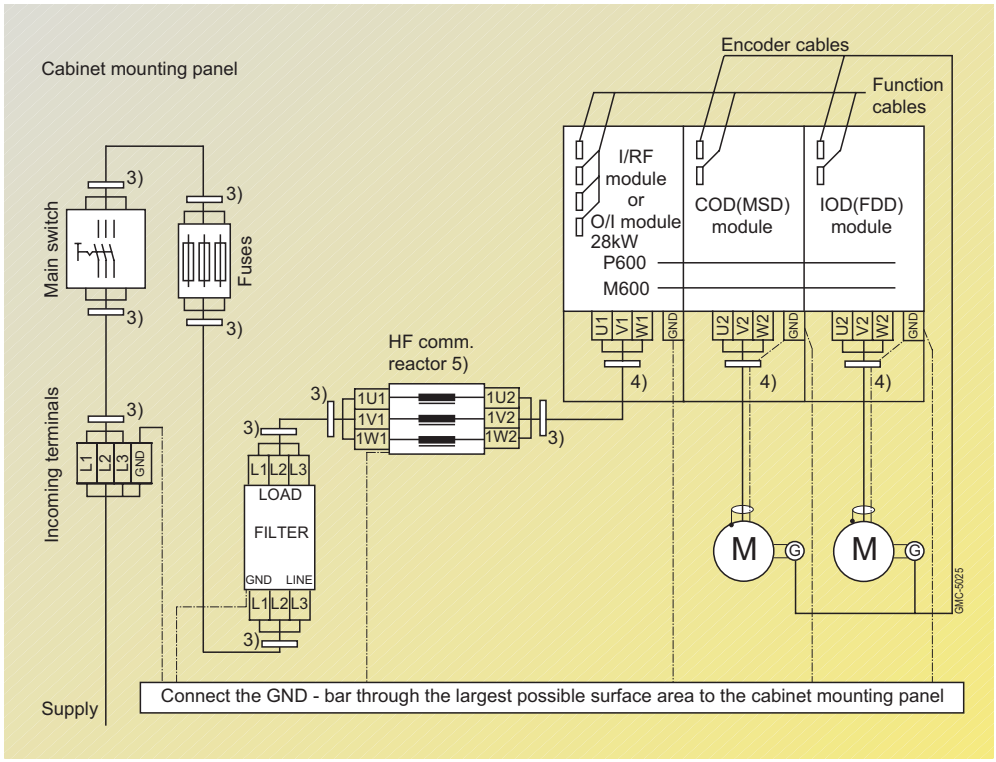



Fig. 6/59
Connecting diagram for the line filter for I/R modules, 16 kW to 120 kW. The connecting diagram is also valid for O/I 28 kW.

1) Unregulated/non-regenerative unit.

2) Regulated/regenerative unit.

3) Shield connection, connected through the largest possible surface area with the cabinet mounting panel.

4) Shield connection at the module-specific connecting plate.

5) For the permissible commutating reactors for I/R module, sinusoidal operation refer to chapter 3. Permissible commutating reactor for 28 kW O/I module, refer to chapter 3. When routing cables in the cabinet, a clearance of > 100 mm must be kept around the HF reactor.

## I/RF modules[1]) w/filter package

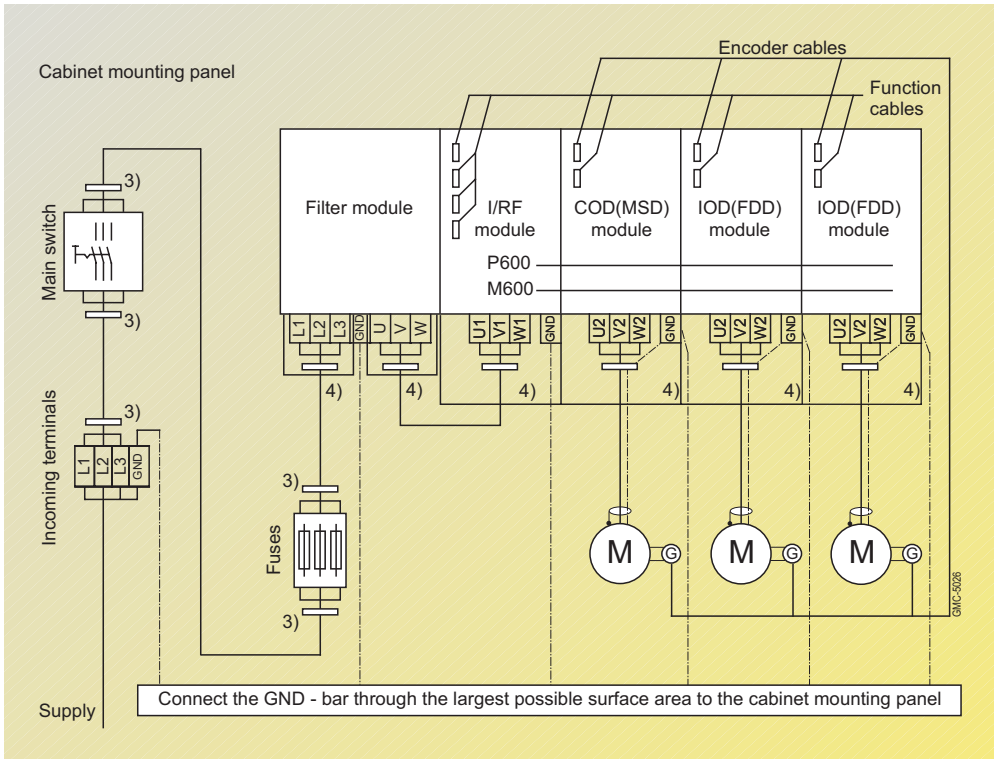



Fig. 6/60
Connecting diagram for line filters for 5 kW and 10 kW O/I modules.

## I/RF infeed module[1]) w/parallel filters

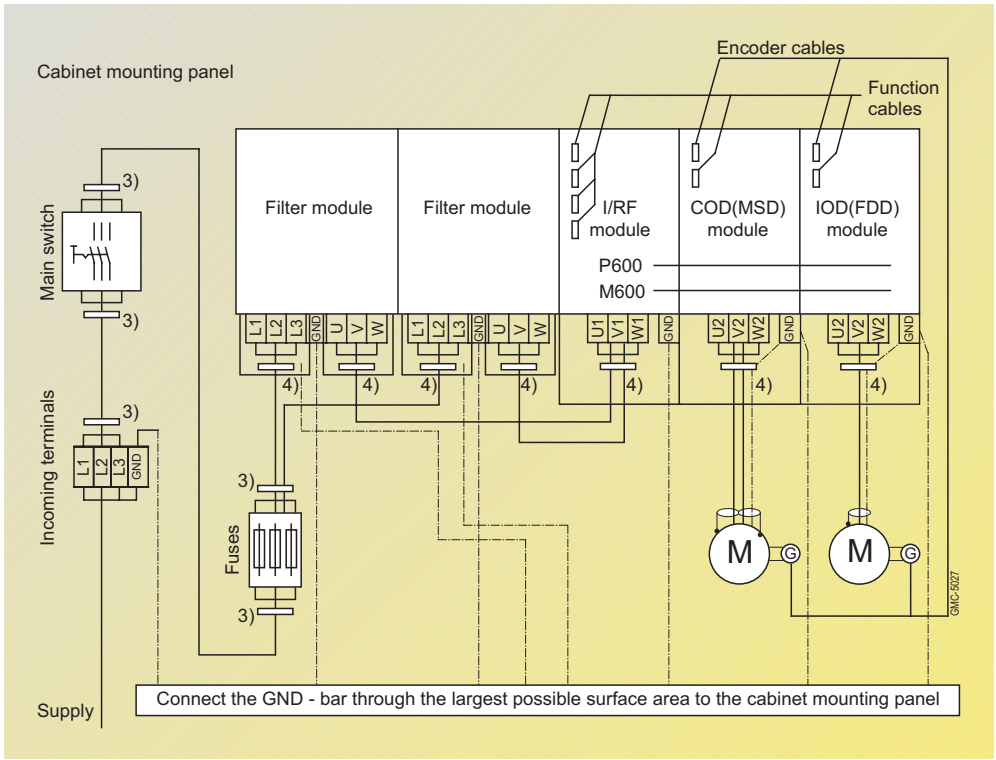



Fig. 6/61
Connecting diagram for two filter modules, connected in parallel for 80 kW and 120 kW I/R modules.

1) Regulated/regenerative unit.

2) Shield connection, connected through the largest possible surface area with the cabinet mounting panel.

3) Shield connection at the module-specific connecting panel.

4) The potential bonding conductor is an additional protection so that no inadmissibly high contact voltages can occur at the filter module.

## Infeed module · Standard circuit connections

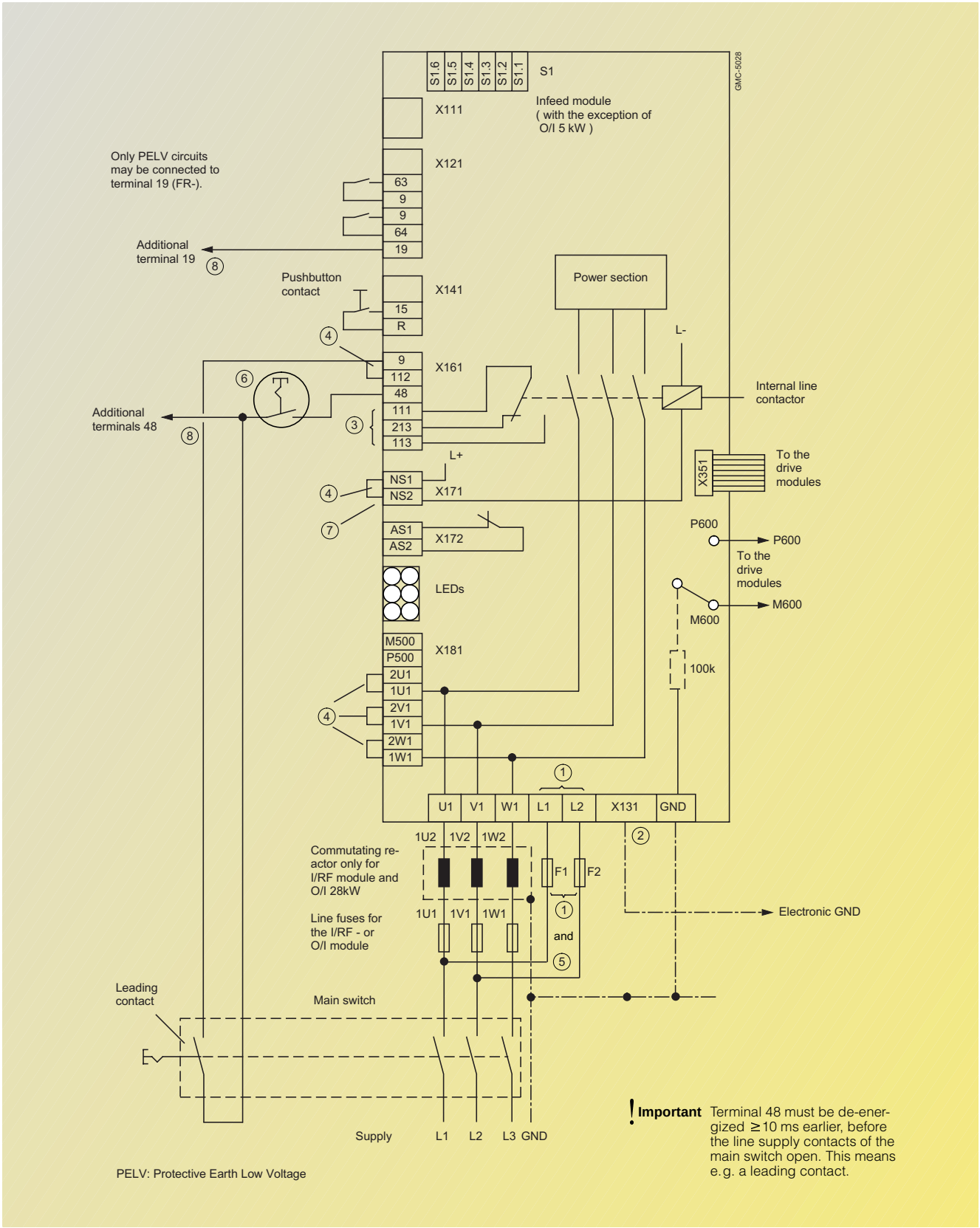



Fig. 6/62

### *Legend for Figure 6/62*

① Terminals L1, L2 are only available for the 80/104 kW and 120/156 kW I/RF modules.

In this case, $I_{n\ fuse}$ must be ≥4 A. Version: gL.

② For a coupling to a numerical control, X131 must be connected with the NC reference potential. This cable is routed in parallel to the speed setpoint cable.

③ Signaling contact, of the internal line contactor

Terminals 111/113:
NO contact

Terminals 111/213:
NC contacts

Terminals 111/213:
positively driven to the load contacts, refer to infeed (NE) modules.

④ Jumpers inserted in the equipment when supplied.

**Caution**

⑤ For the 80/104 kW or 120/156 kW I/RF modules, if the line voltage at terminal L1, L2 fails, or fuses F1, F2 rupture, then the I/RF module pulses are inhibited, and the internal line contactor drops out. This is indicated by the supply fault LED, the ready relay and via the contactor signaling contacts. In this case, to re-close the internal line contactor, terminal 48 must be deenergized, and after ≥1 s re-energized or the drive must be powered-down/powered-up.

⑥ If an 80/104 kW or 120/156 kW I/RF module is used, jumper terminal 9/48 must be removed, and a switch used (due to Point 5). The switch is not required if the drive converter is powered-down and up again using the main switch (supply).

⑦ Max. cable length for AWG 16/1.5 mm$^2$ cross-section; 164 ft (50 m) (2-wire cable). This should be linearly decreased for lower cross-sections.

⑧ A maximum of 6 x terminals 48 may be connected in parallel, to shutdown max. 6 infeed (NE) modules using a leading contact of the main switch. Max. cable length for AWG 1.5 mm$^2$ cross-section; 492 ft (150 m) (2-conductor cable). Linearly reduced for lower cross-sections.

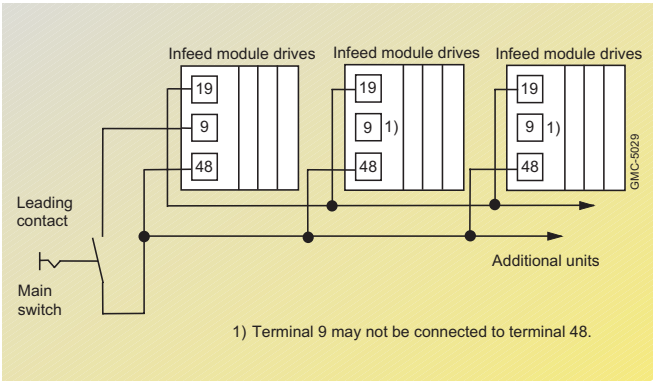



Fig. 6/63
Connection diagram

If more than 6 infeed (NE) modules are to be connected to a main switch, then an external 24 V supply must be provided. Current drain terminal 48 = 35 mA; the minimum input voltage of terminal 48 must be observed (13 V). Additional loads connected to the external 24 V power supply must be provided with an overvoltage limiting circuit (e.g. free-wheeling diode).

1) Terminal 9 may not be connected to terminal 48.

## System overview

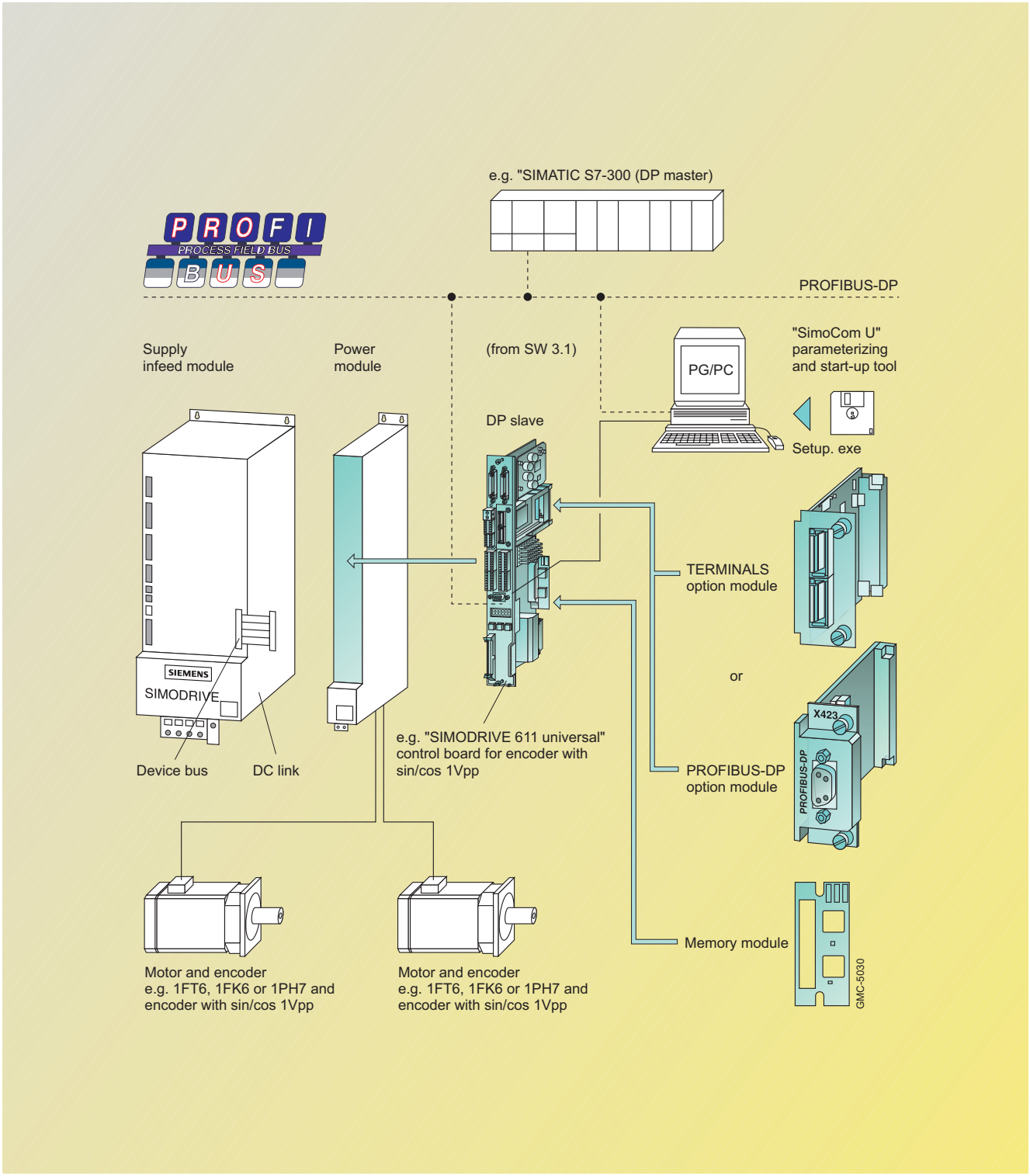



Fig. 6/64
System overview

The SIMODRIVE 611 drive converter system with "SIMODRIVE 611 universal" control board can comprise the individual components and higher-level control components as shown in the overview.

## SIMODRIVE 611 universal infeed modules

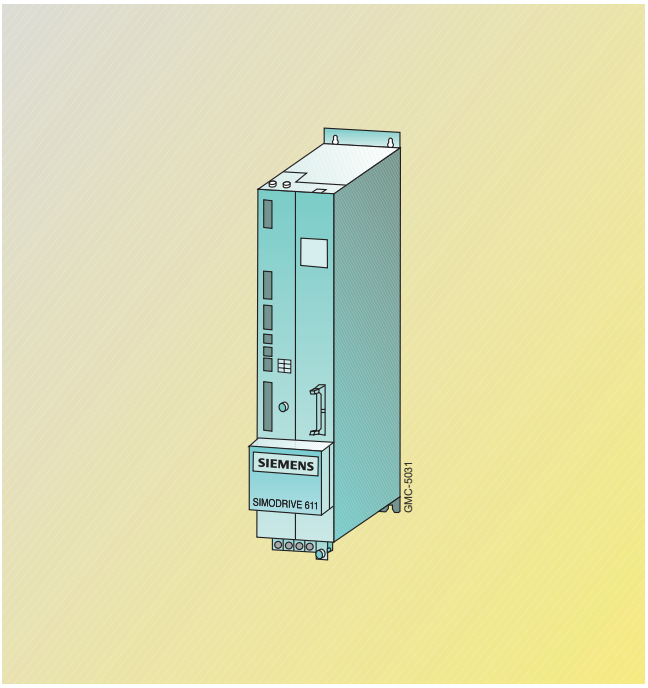



Fig. 6/65
7.9 in (200 mm) module

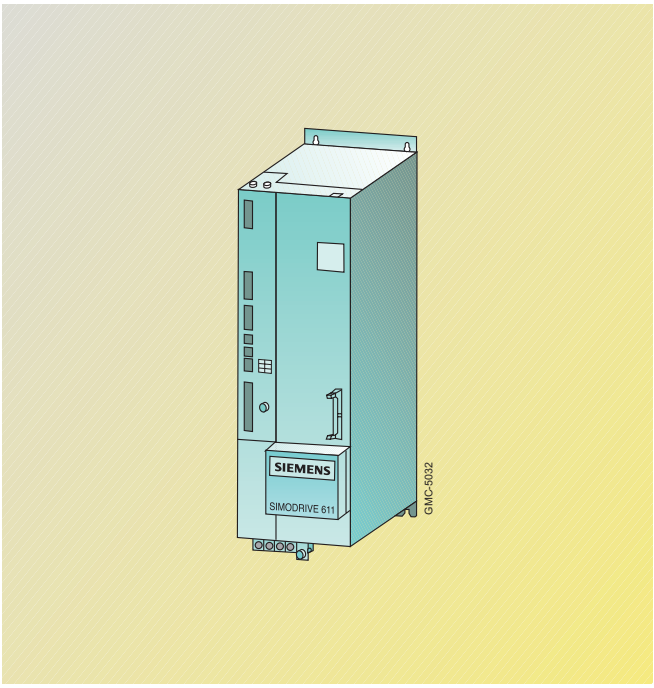



Fig. 6/66
11.8 in (300 mm) module

## Selection and ordering data

| Unregulated control with pulsed resistor | Regulated control with regenerative feedback | Module width | | **Infeed module for internal cooling** | **Infeed module for external cooling[1])** | **Infeed module for hose cooling** | Max. supply conductor cross-section U1, V1, W1 | |
|---|---|---|---|---|---|---|---|---|
| Rated power (S1) | Rated power (S1) | | | | | (Hose connection kit required) | | |
| HP (kW) | HP (kW) | in | (mm) | Order No. | Order No. | Order No. | $mm^2$ | AWG |
| 6.5 ( 5) | – | 1.97 | ( 50) | **6SN11 46-1AB00-0BA1** | **6SN11 46-1AB00-0BA1** | **–** | 6 | 10 |
| 13.5 (10) | – | 3.9 | (100) | **6SN11 45-1AA01-0AA1** | **6SN11 45-1AA01-0AA1** | **–** | 16 | 6 |
| 38 (28) | – | 7.9 | (200) | **6SN11 45-1AA00-0CA0** | **6SN11 46-1AB00-0CA0** | **–** | 50 | 1 |
| – | 22 ( 16) | 3.9 | (100) | **6SN11 45-1BA01-0BA1** | **6SN11 46-1BB01-0BA1** | **–** | 16 | 6 |
| – | 49 ( 36) | 7.9 | (200) | **6SN11 45-1BA02-0CA1** | **6SN11 46-1BB02-0CA1** | **–** | 50 | 1 |
| – | 75 ( 55) | 11.8 | (300) | **6SN11 45-1BA01-0DA1** | **6SN11 46-1BB00-0DA1** | **6SN11 45-1BB00-0DA1** | 95 | 30 |
| – | 109 ( 80) | 11.8 | (300)[2]) | **6SN11 45-1BB00-0EA1** | **6SN11 46-1BB00-0EA1** | **6SN11 45-1BB00-0EA1** | 95 | 30 |
| – | 160 (120) | 11.8 | (300)[2]) | **6SN11 45-1BB00-0FA1** | **6SN11 46-1BB00-0FA1** | **6SN11 45-1BB00-0FA1** | 150 | 300 MCM |

1) For external cooling, the fan box is part of the scope of supply of the mounting frame for the 11.8 in (300 mm) module width. The required 6SN11 62-0BA02-0AA1 built-on fan must be ordered separately.

2) A built-on fan 6SN11 62-0BA02-0AA1 is required for these 11.8 in (300 mm) modules for the internal cooling.

## O/I module 5/10 kW

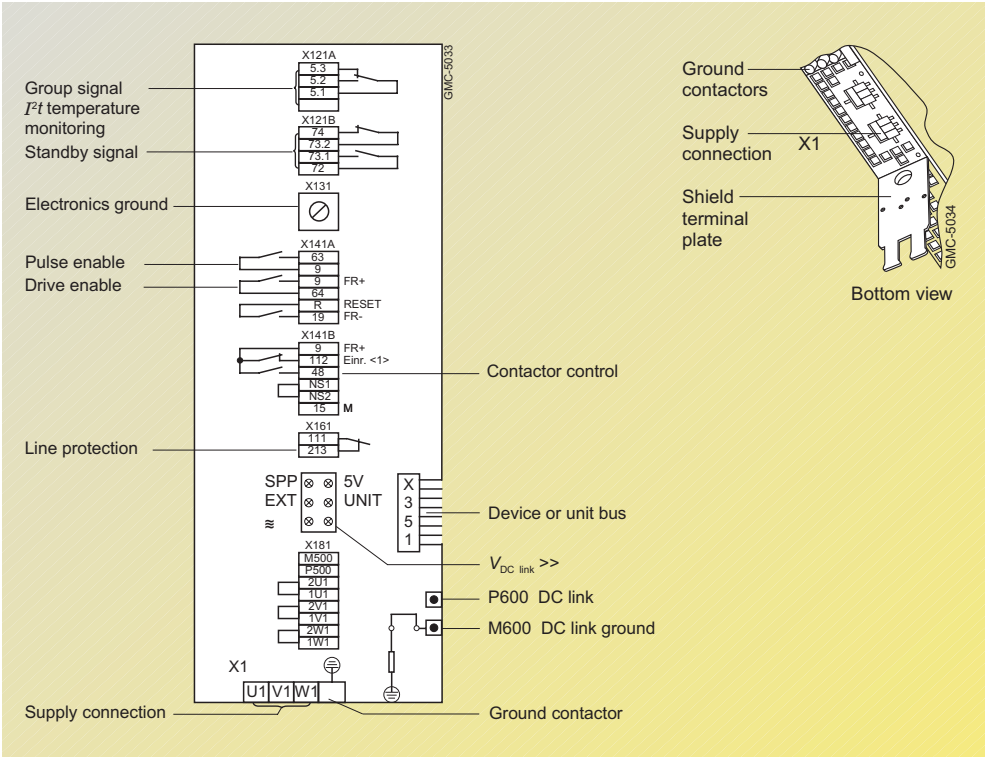



Fig. 6/67

| Terminal No. | Designation | Function | Type[1] | Typ. voltage/limit values | Max. cross-section[6] |
|---|---|---|---|---|---|
| U1<br>V1<br>W1 | X1 | Supply connection | E | 3-ph. 480 V AC | 4 mm² finely-stranded without connector sleeve<br>6 mm² with cable lug |
| GND<br>(PE) | –<br>X131<br>X351 | Protective conductor<br>Electronics GND<br>Equipment bus | I<br>I<br>I/O | 0 V<br>0 V<br>Various | M5 thread<br>M4 thread<br>34-core ribbon cable |
| | | Grounding bar[3] | I/O | –300 V | Busbar |
| P600<br>M600 | | DC link | I/O | +300 V<br>–300 V | Busbar |
| M500<br>P500<br>1U1<br>2U1<br>1V1<br>2V1<br>1W1<br>2W1 | X181<br>X181<br>X181<br>X181<br>X181<br>X181<br>X181<br>X181 | DC link power supply<br>DC link power supply<br>Output L1<br>Input L1<br>Output L2<br>Input L2<br>Output L3<br>Input L3 | I<br>I<br>O<br>I<br>O<br>I<br>O<br>I | –300 V<br>+300 V<br>3-ph. 480 V AC<br>3-ph. 480 V AC<br>3-ph. 480 V AC<br>3-ph. 480 V AC<br>3-ph. 480 V AC<br>3-ph. 480 V AC | 1.5 mm²/AWG 16<br>1.5 mm²/AWG 16<br>1.5 mm²/AWG 16<br>1.5 mm²/AWG 16<br>1.5 mm²/AWG 16<br>1.5 mm²/AWG 16<br>1.5 mm²/AWG 16<br>1.5 mm²/AWG 16 |
| 5.3<br>5.2<br>5.1<br>nc | X121A<br>X121A<br>X121A<br>X121A | Relay contact<br>Group signal<br>$I^2t$/motor temp. | NC<br>NO<br>I | 50 V DC/0.5 A/<br>12 VA max.<br>5 V DC/3 mA min | 1.5 mm²/AWG 16<br>1.5 mm²/AWG 16<br>1.5 mm²/AWG 16<br>1.5 mm²/AWG 16 |
| 74<br>73.2<br>73.1<br>72 | X121B<br>X121B<br>X121B<br>X121B | Relay signal<br>Ready/fault | NC<br>I<br>I<br>NO | 1-ph. 250 V AC/50 V DC/<br>2 A max.<br>5 V DC/3 mA min | 1.5 mm²/AWG 16<br>1.5 mm²/AWG 16<br>1.5 mm²/AWG 16<br>1.5 mm²/AWG 16 |
| 63[2]<br>9[2][4]<br>9[2][4]<br>64[2]<br>R[5]<br>19 | X141A<br>X141A<br>X141A<br>X141A<br>X141A<br>X141A | Pulse enable<br>FR+<br>FR+<br>Drive enable<br>RESET<br>FR-, reference ground enable voltage | I<br>O<br>O<br>I<br>I<br>O | +13 V...30 V/$R_E$ = 1.5 kΩ<br>+24 V<br>+24 V<br>+13 V...30 V/$R_E$ = 1.5 kΩ<br>Terminal 19/$R_E$ = 10 kΩ | 1.5 mm²/AWG 16<br>1.5 mm²/AWG 16<br>1.5 mm²/AWG 16<br>1.5 mm²/AWG 16<br>1.5 mm²/AWG 16<br>1.5 mm²/AWG 16 |
| 111<br>213 | X161<br>X161 | Signaling contact<br>Line contactor | I<br>NC | 1-ph. 250 V AC/50 V DC/2 A<br>17 V DC/3 mA min | 1.5 mm²/AWG 16<br>1.5 mm²/AWG 16 |
| 9[2][4]<br>112<br>48<br>NS1<br>NS2<br>15 | X141B<br>X141B<br>X141B<br>X141B<br>X141B<br>X141B | FR+<br>Setting-up no-/standard mode<br>Contactor control<br>Coil contact for line-,<br>pre-charging contactor<br>M | O<br>I<br>I<br>O<br>I<br>O | +24 V<br>+13 V...30 V/$R_E$ = 1.5 kΩ<br>+13 V...30 V/$R_E$ = 1.5 kΩ<br>+24 V<br>0/+24 V<br>0 V | 1.5 mm²/AWG 16<br>1.5 mm²/AWG 16<br>1.5 mm²/AWG 16<br>1.5 mm²/AWG 16<br>1.5 mm²/AWG 16<br>1.5 mm²/AWG 16 |

**Note:**
For O/I 5 kW, the DC link is precharged through two phases. If a DC link voltage is not established, in spite of the fact that all of the enable signals are present (there is no ready signal), it must be checked that all of the three phases are connected to terminals U1, V1, W1.

**Caution**
Terminals 7, 45, 44 and 10 are not available for O/I 5/10 kW.

1) I = input; O = output; NC = NC contact; NO = NO contact.

2) Terminal 19 is the reference terminal (this is connected in the module with 10 kΩ to general reference ground X131). It is not permissible to connect terminal 15 with PE or with terminal 19, further, no external voltage sources may be connected to terminal 15. Terminal 19 may be connected to terminal X131. The terminal may only be used to enable the associated drive group.

3) The grounding bar is used to ground the DC link GND rail through 100 kΩ.

4) Max. current load of terminal 9 – terminal 19 ≤ 1 A.

5) RESET = Resets the fault memory, edge triggered for the complete drive group (Terminal "R" → Terminal 19 = RESET).

6) For UL certification, only use copper cables which are designed for an operating temperature of ≥ 60 °C.

## SIMODRIVE 611 universal power modules

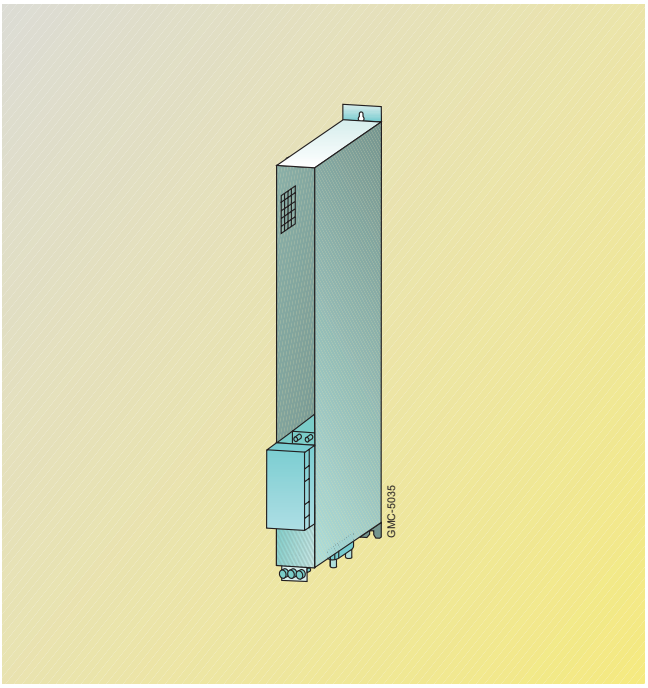



Fig. 6/68
1.97 in (50 mm) module

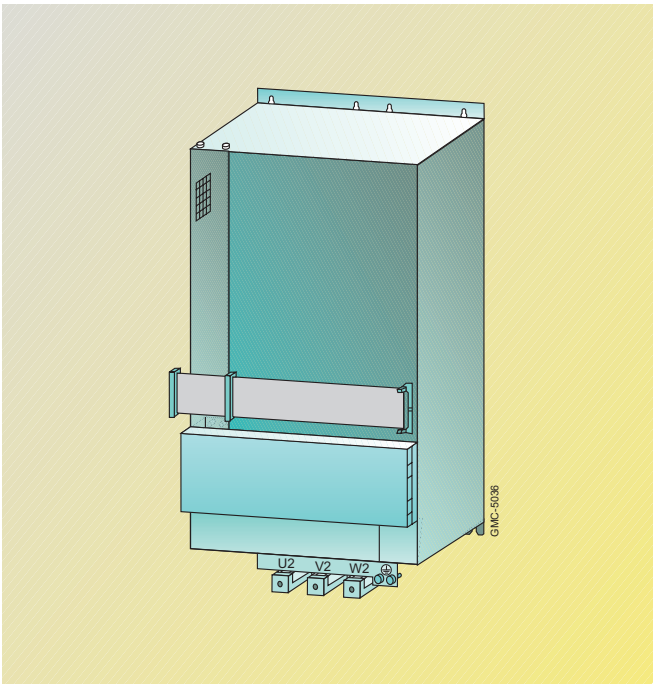



Fig. 6/69
11.8 in (300 mm) module

## Selection and ordering data

| Module width | | In main spindle drives with 1FT6 motors 1FK6 motors 1FN motors | | In main spindle drives with 1PH motors Induction motors | | | **Power module for internal cooling[1])** | **Power module for external cooling[2])** | **Power module for hose cooling[3])** Hose connection kit required, for Order No. see notes below | Max. motor connection conductor cross-section U2, V2, W2 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| in | (mm) | $I_n$ | $I_{max.}$ | $I_n$ | $I_{s640\%}$ | $I_{max.}$ | Order No. | Order No. | Order No. | $mm^2$ | AWG |
| **1-axis version** | | | | | | | | | | | |
| 1.97 | ( 50) | 3/ | 6 A | 3/ | 3/ | 3 A[4]) | **6SN11 23-1AA00-0HA1** | **6SN11 24-1AA00-0HA1** | – | 6 | 10 |
| 1.97 | ( 50) | 5/ | 10 A | 5/ | 5/ | 8 A[4]) | **6SN11 23-1AA00-0AA1** | **6SN11 24-1AA00-0AA1** | – | 6 | 10 |
| 1.97 | ( 50) | 9/ | 18 A | 8/ | 10/ | 16 A[4]) | **6SN11 23-1AA00-0BA1** | **6SN11 24-1AA00-0BA1** | – | 6 | 10 |
| 1.97 | ( 50) | 18/ | 36 A | 24/ | 32/ | 32 A | **6SN11 23-1AA00-0CA1** | **6SN11 24-1AA00-0CA1** | – | 6 | 10 |
| 3.9 | (100) | 28/ | 56 A | 30/ | 40/ | 51 A | **6SN11 23-1AA00-0DA1** | **6SN11 24-1AA00-0DA1** | – | 16 | 6 |
| 5.89 | (150) | – | | 45/ | 60/ | 76 A | **6SN11 23-1AA00-0LA1** | **6SN11 24-1AA00-0LA1** | – | 50 | 1 |
| 5.89 | (150) | 56/ | 112 A | 60/ | 80/ | 102 A | **6SN11 23-1AA00-0EA1** | **6SN11 24-1AA00-0EA1** | – | 50 | 1 |
| 11.8 | (300) | 70/ | 140 A | 85/ | 110/ | 127 A[5]) | **6SN11 23-1AA01-0FA1** | **6SN11 24-1AA01-0FA1** | **6SN11 23-1AA02-0FA1** | 95 | 30 |
| 11.8 | (300) | – | | 120/ | 150/ | 193 A | **6SN11 23-1AA00-0JA1** | **6SN11 24-1AA00-0JA1** | **6SN11 23-1AA00-0JA1** | 95 | 30 |
| 11.8 | (300) | 140/ | 210 A | 200/ | 250/ | 257 A | **6SN11 23-1AA00-0KA1** | **6SN11 24-1AA00-0KA1** | **6SN11 23-1AA00-0KA1** | 150 | 300 MCM |
| **2-axis version** | | | | | | | | | | | |
| 1.97 | ( 50) | 2 x 3/ | 6 A | 3/ | 3/ | 8 A[6]) | **6SN11 23-1AB00-0HA1** | **6SN11 24-1AB00-0HA1** | – | 6 | 10 |
| 1.97 | ( 50) | 2 x 5/ | 10 A | 5/ | 5/ | 8 A[6]) | **6SN11 23-1AB00-0AA1** | **6SN11 24-1AB00-0AA1** | – | 6 | 10 |
| 1.97 | ( 50) | 2 x 9/ | 18 A | 8/ | 10/ | 16 A[6]) | **6SN11 23-1AB00-0BA1** | **6SN11 24-1AB00-0BA1** | – | 6 | 10 |
| 3.9 | (100) | 2 x 18/ | 36 A | on request[6]) | | | **6SN11 23-1AB00-0CA1** | **6SN11 24-1AB00-0CA1** | – | 6 | 10 |

1) **Internal cooling**
A **built-on fan** is required for the power modules 6SN11 23-1AA00-0JA1 and ...-0KA1;
Order No.: **6SN11 62-0BA02-0AA1**.

2) **External cooling**
The fan box is supplied with the mounting frame for the 11.820 in (300 mm) module width for external cooling. The corresponding **built-on fan** must be ordered separately:
Order No.: **6SN11 62-0BA02-0AA1**.

3) **Hose cooling**
A hose cooling assembly kit with fan hose flanges and filter mat is required for each module. Order No. for the **hose cooling assembly kit: 6SN11 62-0BA03-0AA1.**

4) For standard induction motors only.

5) For hose cooling in 2-tier installations (permissible only for 55 kW I/RF [aka. I/R] modules and 85 A induction motors): **Hose connection kit 2-tier installation;**
Order No.: **6SN11 61-0BA03-0CA1.**

6) With SIMODRIVE 611 universal, can be used for 1FE1 and induction motors.

## Power module (1- and 2-axis)

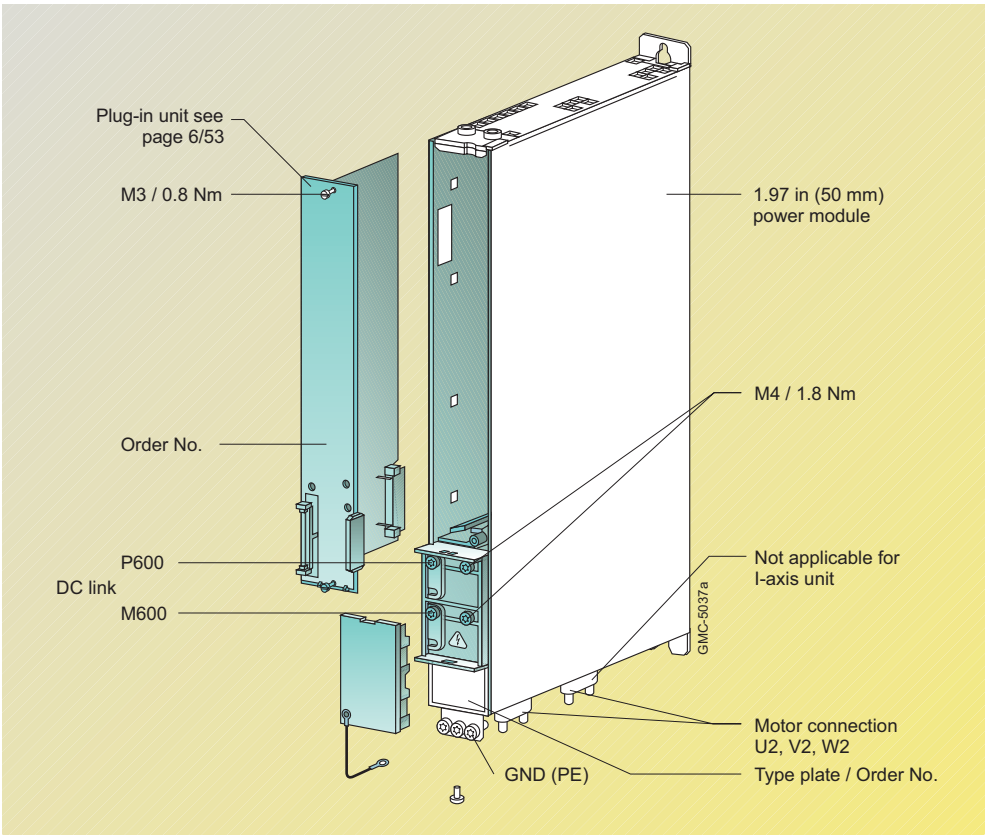



Fig. 6/70
1.97 in (50 mm) power module

| Terminal No. | Designation | Function | Type[1]) | Typ. voltage/limit values | Max. cross-section |
|---|---|---|---|---|---|
| **1-axis version** | | | | | |
| U2<br>V2<br>W2 | A1 | Motor connection | A | 3-ph. 600 V AC | Refer to page 6/49 |
| PE<br>(GND) | ⏚ | Protective conductor<br>Protective conductor | I<br>I | 0 V<br>0 V | 2 screws |
| P600<br>M600 | | DC link<br>DC link | I/O<br>I/O | +300 V<br>–300 V | Busbar<br>Busbar |
| **2-axis version** | | | | | |
| U2<br>V2<br>W2 | A1 | Motor connection for axis 1 | A | 3-ph. 600 V AC | Refer to page 6/49 |
| U2<br>V2<br>W2 | A2 | Motor connection for axis 2 | A | 3-ph. 600 V AC | Refer to page 6/49 |
| PE<br>(GND) | | Protective conductor<br>Protective conductor | I<br>I | 0 V<br>0 V | 3 screws |
| P600<br>M600 | | DC link<br>DC link | I/O<br>I/O | +300 V<br>–300 V | Busbar<br>Busbar |

1) O = Output; I = Input

## Infeed modules (O/I and I/R) expect O/I 5/10 kW

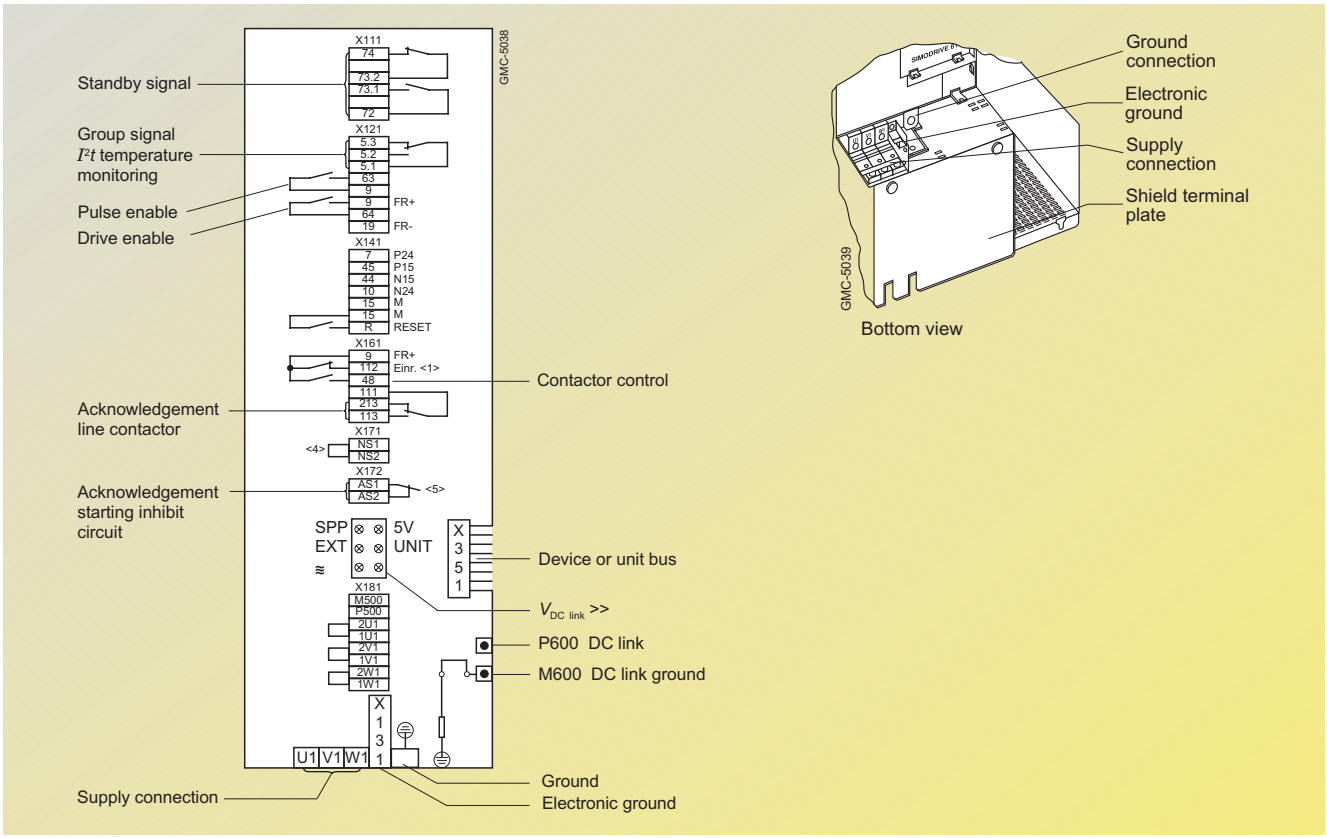



Fig. 6/71

| Terminal No. | Designation | Function | Type[1] | Typ. voltage/ limit values | Max. cross-section[2] | Terminals available in[3] |
|---|---|---|---|---|---|---|
| U1<br>V1<br>W1 | | Supply connection | E | 3-ph. 480 V AC | Refer to page 6/63 | I/R, O/I |
| L1<br>L2 | | Contactor supply | I<br>I | 2-ph. 480 V AC, directly from the supply, L1, L2, L3 | 16 mm²/10 mm² [5]<br>16 mm²/10 mm² [5]<br>AWG 6/8 | I/R 80/104 kW, 120/156 kW |
| Ground (PE)<br>P600<br>M600 | | Protective conductor<br>DC link<br>DC link | I<br>I/O<br>I/O | 0 V<br>+300 V<br>–300 V | Bolt<br>Busbar<br>Busbar | I/R, O/I |
| | | Grounding bar[6] | I/O | –300 V | Busbar | I/R, O/I |
| 1R, 2R, 3R | TR1, TR2[4] | External resistance connection | I/O | V300 | 6 mm²/4 mm² [5]<br>AWG 10/12 | O/I 28 kW |
| | X131 | Electronics M | I/O | 0 V | 16 mm²/10 mm² [5]<br>AWG 6/8 | I/R, O/I |

1) I = Input; O = Output; NC = NC contact; NO = NO contact; (for signal, NO = high; NC = low).

2) For UL certification, only use copper cables which are designed for a ≥60 °C operating temperature.

3) I/R = Infeed/regenerative feedback module; O/I = non-regenerative.

4) Only for O/I 28 kW.

5) The 1st number is valid for cable lugs. The 2nd number is valid for finely-stranded conductors without connector sleeve.

6) The grounding bar is used to ground the DC link rail through 100 kΩ.

## Infeed modules (O/I and I/R) except O/I 5/10 kW

| Terminal No. | Designation | Function | Type[1]) | Typ. voltage/ limit values | Max. cross-section[2]) | Terminals available in[3]) |
|---|---|---|---|---|---|---|
| | X151 | Equipment bus | I/O | Various | Ribbon cable | I/R, O/I |
| M500 | X181 | DC link power supply | I | DC –300 V | 1.5 mm²/AWG 16 | I/R, O/I |
| P500 | X181 | DC link power supply | I | DC +300 V | 1.5 mm²/AWG 16 | |
| 1U1 | X181 | Output L1 | O | 3-ph. 400 V AC | 1.5 mm²/AWG 16 | |
| 2U1 | X181 | Input L1 | I | 3-ph. 400 V AC | 1.5 mm²/AWG 16 | |
| 1V1 | X181 | Output L2 | O | 3-ph. 400 V AC | 1.5 mm²/AWG 16 | |
| 2V1 | X181 | Input L2 | I | 3-ph. 400 V AC | 1.5 mm²/AWG 16 | |
| 1W1 | X181 | Output L3 | O | 3-ph. 400 V AC | 1.5 mm²/AWG 16 | |
| 2W1 | X181 | Input L3 | I | 3-ph. 400 V AC | 1.5 mm²/AWG 16 | |
| 7 | X141 | P24 | O | +20.4 ... 28.8 V/50 mA | 1.5 mm²/AWG 16 | I/R, O/I |
| 45 | X141 | P15 | O | +15 V/10 mA | 1.5 mm²/AWG 16 | |
| 44 | X141 | N15 | O | –15 V/10 mA | 1.5 mm²/AWG 16 | |
| 10 | X141 | N24 | O | –20.4 ... 28.8 V/50 mA | 1.5 mm²/AWG 16 | |
| 15[4]) | X141 | M | O | 0 V | 1.5 mm²/AWG 16 | |
| R[6]) | X141 | RESET | I | Term. 15/$R_E$ = 10 kΩ | 1.5 mm²/AWG 16 | |
| 5.3 | X121 | Relay contact | NC | 50 V DC/0.5 A/12 VA max. | 1.5 mm²/AWG 16 | I/R, O/I |
| 5.2 | X121 | Group signal | NO | 5 V DC/3 mA min | 1.5 mm²/AWG 16 | |
| 5.1 | X121 | $I^2t$/motor temp. | I | | 1.5 mm²/AWG 16 | |
| 63[4]) | X121 | Pulse enable | I | +13 V ... 30 V/$R_E$ = 1.5 kΩ | 1.5 mm²/AWG 16 | |
| 9[4])[5]) | X121 | Enable voltage | O | +24 V | 1.5 mm²/AWG 16 | |
| 9[4])[5]) | X121 | Enable voltage | O | +24 V | 1.5 mm²/AWG 16 | |
| 64[4]) | X121 | Drive enable | I | +13 V ... 30 V/$R_E$ = 1.5 kΩ | 1.5 mm²/AWG 16 | |
| 19 | X121 | Enable voltage, reference potential | | 0 V | 1.5 mm²/AWG 16 | |
| 74 | X111 | | NC | | 1.5 mm²/AWG 16 | I/R, O/I |
| nc | X111 | | | | 1.5 mm²/AWG 16 | |
| 73.2 | X111 | Relay contact | I | 1-ph. 250 V AC/50 V DC/2 A | 1.5 mm²/AWG 16 | |
| 73.1 | X111 | Ready signal | I | max. | 1.5 mm²/AWG 16 | |
| nc | X111 | | | 5 V DC/3 mA min | 1.5 mm²/AWG 16 | |
| 72 | X111 | | NO | | 1.5 mm²/AWG 16 | |
| 9[4])[5]) | X161 | Enable voltage | O | +24 V | 1.5 mm²/AWG 16 | I/R, O/I |
| 112[4]) | X161 | Setting-up mode/ Standard mode | I | +21 V ... 30 V/$R_E$ = 1.5 kΩ | 1.5 mm²/AWG 16 | |
| 48[4]) | X161 | Contactor control | E | +13 V ... 30 V/$R_E$ = 1.5 kΩ | 1.5 mm²/AWG 16 | I/R, O/I |
| 111[7]) | X161 | Signaling | E | +30 V/1 A (111-113) | 1.5 mm²/AWG 16 | |
| 213[7]) | X161 | contacts | Ö | 1-ph. 250 V AC/50 V DC/ | 1.5 mm²/AWG 16 | |
| 113[7]) | X161 | Line contactor | NO | 2 A max. 17 V DC/3 mA min | 1.5 mm²/AWG 16 | |
| AS1 | X172 | Signaling contact | I | 250 V AC/1 A/50 V DC/2 A max. | 1.5 mm²/AWG 16 | I/R |
| AS2 | X172 | Start inhibit (terminal 112) | NC | 5 V DC/10 mA min | 1.5 mm²/AWG 16 | |
| NS1 | X171 | Coil contact for | O | +24 V | 1.5 mm²/AWG 16 | I/R, O/I |
| NS2 | X171 | line-, pre-charging contactor | I | | 1.5 mm²/AWG 16 | |

1) I = Input; O = Output; NC = NC contact; NO = NO contact; (for signal, NO = high; NC = low).

2) For UL certification, only use copper cables which are designed for a ≥60 °C operating temperature.

3) I/R = Infeed/regenerative feedback module; O/I = non-regenerative

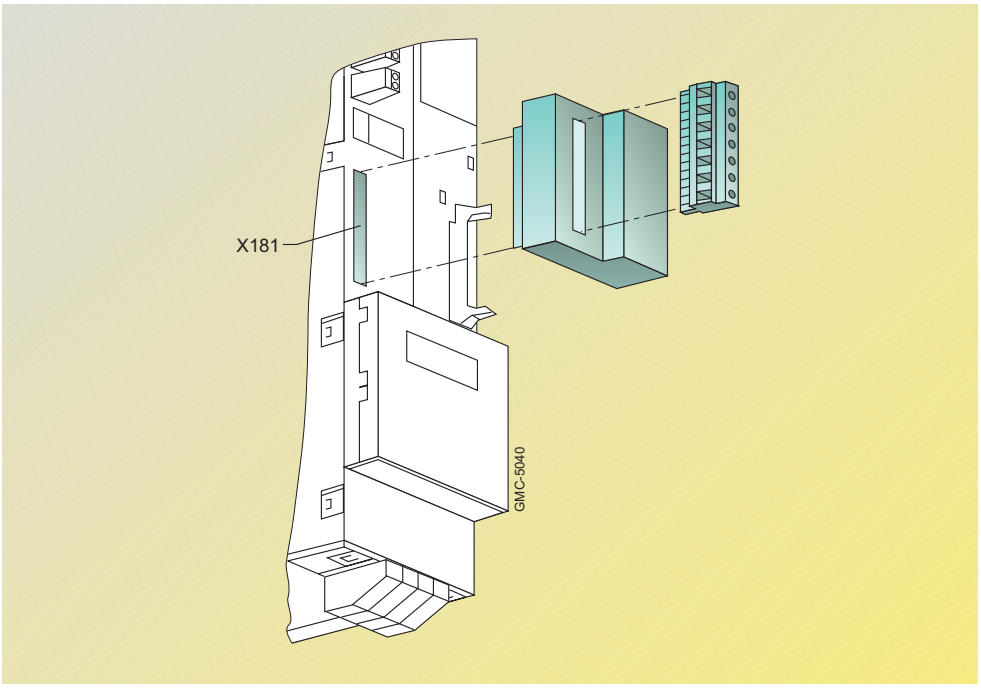
4) Terminal 19 is the reference ground (connected inside the module with 10 kΩ to the general reference ground X131/terminal 15). It is not permissible that terminal 15 is connected to PE or terminal 19, further, no external voltage sources may be connected to terminal 15. Terminal 19 may be connected to X131. The terminal may only be used to enable the associated drive group.

5) Maximum current load of terminal 9 with respect to 19: 0.5 A.

6) RESET = Resets the error memory, edge triggered for the complete drive group (Terminal "R" → Terminal 15 = RESET).

7) Terminals 111-213, positively-driven NC contact (for I/R 16 kW and O/I 10 kW only from Order No.: 6SN11 4□-1□□01-0□□□). Terminals 111-113 NO contacts, not positively driven.

## SIMODRIVE 611 overvoltage limiter module (surge arrestor)



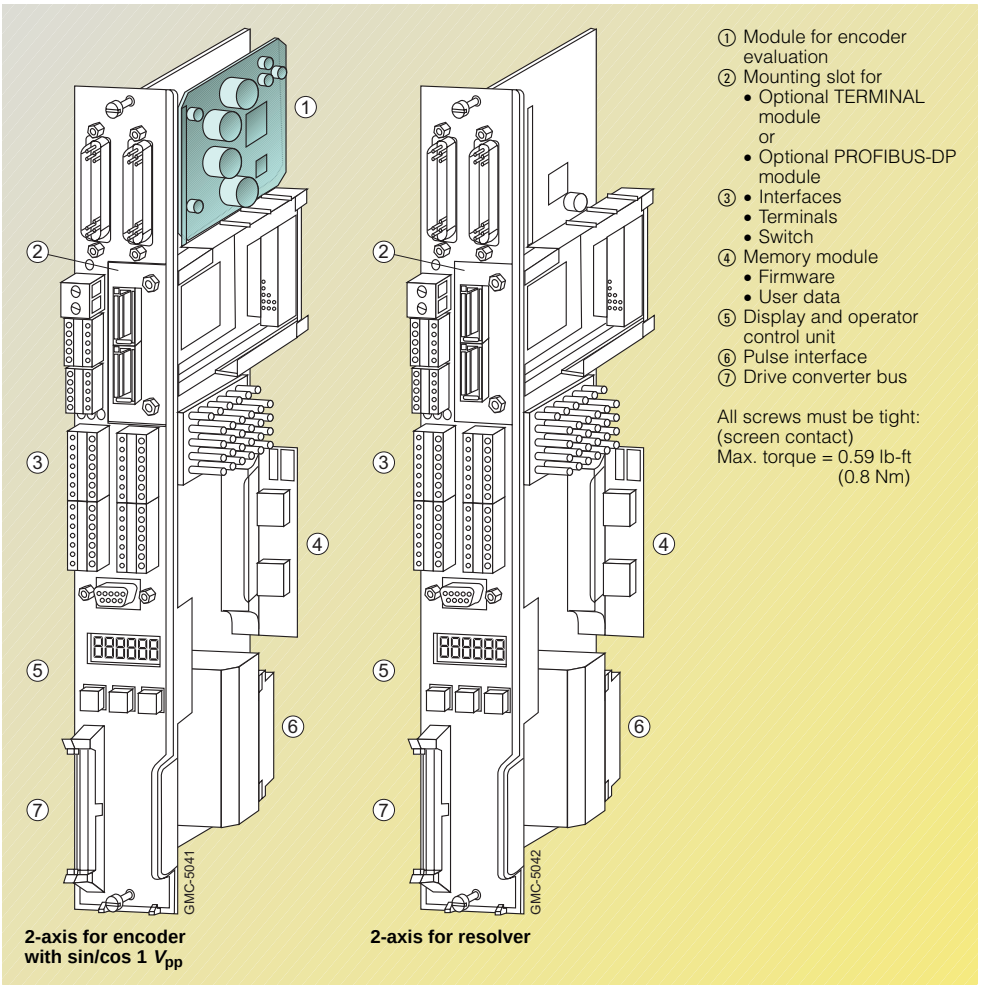

The overvoltage limiter module limits the overvoltages that occur as the result of, for example, switching operations on inductive consumers and on network matching transformers to values acceptable for the infeed modules above 10 kW (3.940 in [100 mm] width). It is inserted at interface X181.
The overvoltage limiter module is used for upstream transformers or networks that do not meet IEC requirements.
For UL compliance of the infeed module the overvoltage limiter module must be used
An appropriate protective circuit is integrated as standard in the 5 kW OI module

### Ordering data

**Overvoltage limiter module**
for mains infeed modules above 10 kW for SIMODRIVE 611
Order No.
**6SN11 11-0AB00-0AA0**

Fig. 6/72
Overvoltage limiter module

## SIMODRIVE 611 universal plug-in unit




**2-axis for encoder with sin/cos 1 $V_{pp}$**

**2-axis for resolver**

① Module for encoder evaluation
② Mounting slot for
- Optional TERMINAL module
or
- Optional PROFIBUS-DP module

③ • Interfaces
• Terminals
• Switch
④ Memory module
- Firmware
- User data

⑤ Display and operator control unit
⑥ Pulse interface
⑦ Drive converter bus

All screws must be tight: (screen contact)
Max. torque = 0.59 lb-ft (0.8 Nm)

The following 2-axis control boards are available:

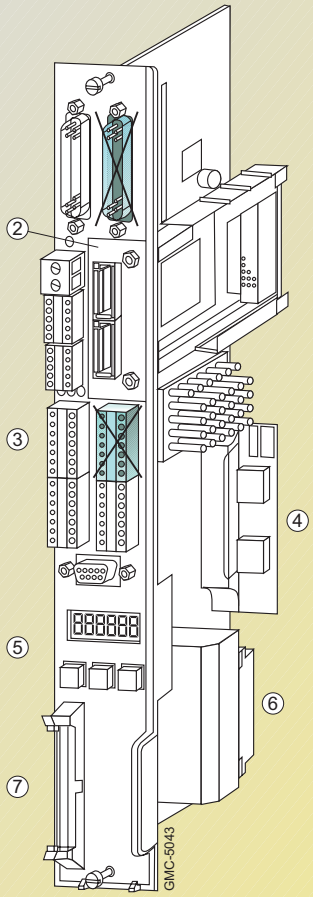
### Ordering data

**SIMODRIVE 611 universal**
closed-loop control plug-in unit with analog speed setpoint interface

- 2-axis version
sin/cos 1 $V_{pp}$/absolute encoder, speed/torque setpoint
Order No.
**6SN11 18-0NH00-0AA1**
- 2-axis version
sin/cos 1 $V_{pp}$/absolute encoder, speed/torque setpoint,
positioning
Order No.
**6SN11 18-1NH00-0AA1**
- 2-axis version
resolver,
speed/torque setpoint
Order No.
**6SN11 18-0NK00-0AA1**
- 2-axis version
resolver,
speed/torque setpoint,
positioning
Order No.
**6SN11 18-1NK00-0AA1**

Fig. 6/73
Control board for 2-axis version

## SIMODRIVE 611 universal plug-in unit




× These interfaces have no function for the 1-axis version

② Mounting slot for
- Optional TERMINAL module
  or
- Optional PROFIBUS-DP module

③
- Interfaces
- Terminals
- Switch

④ Memory module
- Firmware
- User data

⑤ Display and operator control unit
⑥ Pulse interface
⑦ Drive converter bus

All screws must be tight:
(screen contact)
Max. torque = 0.59 lb-ft (0.8 Nm)

The following 1-axis control board is available:

### Ordering data

**SIMODRIVE 611 universal**
closed-loop control plug-in unit with analog speed setpoint interface

- 1-axis version
  resolver,
  speed/torque setpoint
  Order No.
  **6SN11 18-0NJ00-0AA1**
- 1-axis version
  resolver,
  speed/torque setpoint,
  positioning
  Order No.
  **6SN11 18-1NJ00-0AA1**

Fig. 6/74
Control board for 1-axis version

## SIMODRIVE 611 universal plug-in unit

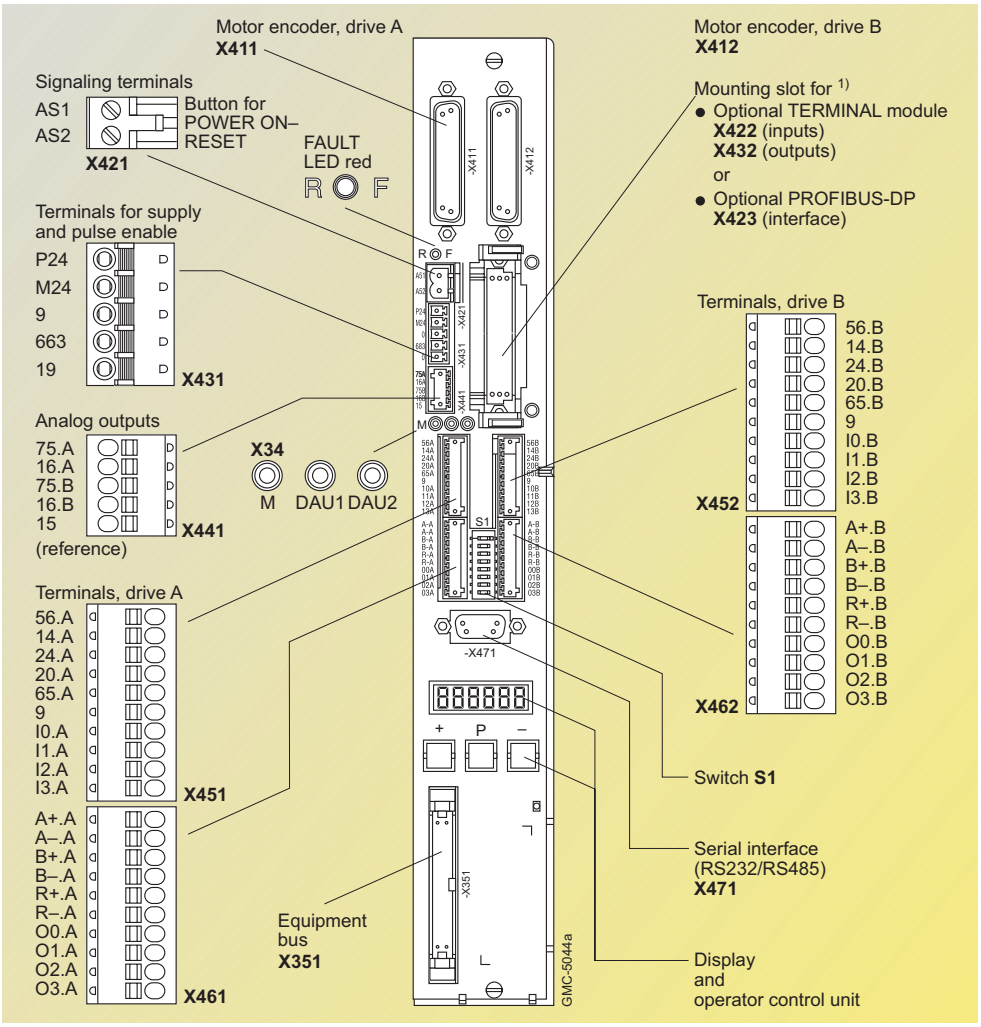
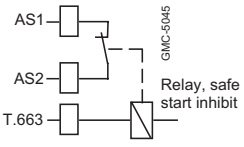



Fig. 6/75
Plug-in unit

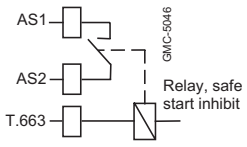
### *Board-specific terminals and interfaces*

The board-specific terminals and interfaces are available for drive A and B.

| Terminal No. | Designation | Function | Type[2] | Technical data | |
|---|---|---|---|---|---|
| **Signaling terminal, start inhibit (X421)** | | | | | |
| AS1 | X421 | Signaling contact Start inhibit | NC | Connector type: | 2-pin connector strip |
| | | | | Max. conductor cross-section: | 2.5 mm²/AWG 14 |
| AS2 | X421 | Checkback signal from terminal 663 | NC | Contact: | Floating NC contact |
| | | | | Contact load: | at 250 $V_{AC}$ max. 1 A at 30 $V_{DC}$ max. 2 A |




Pulses not enabled (T.663)
The gating pulses of the power transistors are inhibited.




Pulses enabled (T.663)
The gating pulses of the power transistors are enabled.

1) Dummy cover removed, no option module inserted.

2) NC contact.

## Start inhibit in the drive modules (SAFE OFF)

**Important**
The functions “safety stop” and “setting-up operation” are not safety functions in the sense of the Machinery Directive 89/392/EEC. They only support the measures which have to be untertaken by the user himself.

### *Using the start inhibit*

The “start inhibit” function is provided in the SIMODRIVE 611 drive modules.

The start inhibit function prevents a synchronous – or induction motor drive unexpectedly starting from standstill. This circuit macro can be used in the “safe standstill” machine function. The external machine control must have initiated and guaranteed that the machine has come to a complete standstill beforehand. The power feed from the converter to the motor is interrupted with the start inhibit (motor rotation). This is based on the Draft IEC 204 No. 44/184/CDV from 15.06.95.

The remaining risk, is in this case, if two errors/faults occur simultaneously in the power section; the motor rotates (jolts) through a small angle (1 FT motors: 4 pole 90°, 6 pole 60°, 8 pole 45°, induction motors: in the vicinity of the remanence, max. 1 slot pitch, which approximately corresponds to 5° 15°.

Electrical isolation is not provided by the start inhibit function, and it does not provide protection against “electric shock”.

The complete machine must always be electrically isolated from the line supply through the main switch if any work is to be carried-out on the machine or system, e.g. maintenance service or cleaning work (EN 60 204/5.3).

The start inhibit function, when correctly used, must be looped-in in the line contactor circuit or emergency off circuit with the positively-driven signaling contact AS1/AS2. The associated drive must be electrically isolated from the supply if the start inhibit relay function is not plausible, referred to the machine operating mode; e.g. via the line contactor in the infeed module. The start inhibit and the associated operating mode may only be used again after the fault has been removed.

## SIMODRIVE 611 universal plug-in unit

| Terminal No. | Designation | Function | Type[1]) | Technical data | |
|---|---|---|---|---|---|
| **Terminals for supply and pulse enable (X431)** | | | | | |
| | **X431** | | | Connector type: | 5-pin connector |
| | | | | Max. conductor cross-section: | 1.5 mm$^2$/AWG 16 |
| P24 | X431.1 | External power supply for digital outputs (+24 V) | V | Voltage tolerance (including ripple): | 10 V to 30 V |
| M24 | X431.2 | Reference for the external supply | V | | |
| The external supply is required for the following digital outputs:<br>• 8 outputs for drive-specific terminals (X461, O0.A – O3.A/X462, O0.B – O3.B)<br>• 8 outputs of the optional TERMINAL module (X432, O4 – O11)<br>When dimensioning the external power supply, the total current of all of the digital outputs must be taken into account.<br>Maximum total current:<br>• for the control board (all 8 outputs):<br>• for the optional TERMINAL module (all 8 outputs): | | | A2.4<br>480 mA | | |
| Example: | | | | | |
| Board/module<br>Control board<br>Control board + optional TERMINAL module | | | Outputs<br>8<br>8 + 8 | Dimensioning the external supply<br>max. 1.5 A<br>max. (1.5 A + 280 mA) | <br>→ 24 V/1.5 A<br>→ 24 V/1.8 A |
| 9 | X431.3 | Enable voltage (+24 V) | V | Reference:<br>Max. current (for the complete group):<br>**Note:** The enable voltage (terminal 9) can be used to provide the enable signals (e.g. pulse enable) as 24 V auxiliary voltage. | T. 19<br>500 mA |
| 663 | X431.4 | Pulse enable (+24 V) | I | Voltage tolerance (including ripple):<br>Current drain, typical:<br>**Note:** The pulse enable acts simultaneously on drive A and drive B. When the pulse enable is withdrawn, the drives “coast down” unbraked. | 21 V to 30 V<br>25 mA at 24 V |
| 19 | X431.5 | Reference (Reference for all digital inputs) | V | **Note:** If the enable signals are to be controlled from an external voltage and not from terminal 9, then the reference potential (ground) of the external source must be connected to this terminal. | |
| **Serial interface (X471)** | | | | | |
| – | X471 | Serial interface for “SimoCom U” | IO | Connector type: 9-pin D-sub socket connector<br>**Note:**<br>• Online operation via the serial RS232/RS485 interface | |
| **Equipment bus (X351)** | | | | | |
| – | X351 | Drive converter bus | IO | Ribbon cable:<br>Voltages:<br>Signals: | 34-pin<br>various<br>various |
| **Test sockets (X34)** | | | | | |
| DAU1 | X34 | Test socket 1[2]) | MA | Test socket: | ∅ 2 mm |
| DAU2 | X34 | Test socket 2[2]) | MA | Resolution: | 8 bit |
| M | X34 | Reference | MA | Voltage range: | 0 V to 5 V |
| | | | | Maximum current: | 3 mA |

## Start inhibit in the drive modules (SAFE OFF) (continued)

As a result of a hazard analysis/risk analysis which must be executed according to the Machinery Directive 89/392/EEC and EN 292; pr EN 954; and pr EN 1050, the machine manufacturer must configure the safety circuit for the complete machine taking into account all of the integrated components for his machine types and version of them. This also includes the electric drives.

1) I = Input; V = Supply; IO = Input/output; MA = Analog measuring signal.

2) Can be freely parameterized.

## SIMODRIVE 611 universal plug-in unit

### *Drive-specific terminals*

The drive-specific terminals are available for both drive A and drive B.

| Terminals | | | | Function | Type[1]) | Technical data |
|---|---|---|---|---|---|---|
| Drive A | | Drive B | | | | |
| No. | Designation | No. | Designation | | | |
| **Encoder connection (X411, X412)** | | | | | | |
| – | X411 | – | – | Motor encoder connection, drive A | I | **Literature:**<br>SIMODRIVE 611, Planning Guide, Section “Indirect and direct position sensing”<br>**Encoder limiting frequencies:**<br>• Encoder with sin/cos 1 $V_{pp}$: 350 kHz<br>• Resolver 375 Hz |
| – | – | – | X412 | Motor encoder connection, drive B | I | |

## Pin assignment of the interface

### *Assignment of X411/X412 for encoders with sin/cos 1 $V_{pp}$*

Connector type: 25-pin D-Sub, plug connector

| Pin | Signal name | Pin | Signal name |
|---|---|---|---|
| 1 | P_Encoder | 14 | 5 V sense |
| 2 | M_Encoder | 15 | EnDat_DAT |
| 3 | A | 16 | 0 V sense |
| 4 | *A | 17 | R |
| 5 | Inner screen | 18 | *R |
| 6 | B | 19 | C |
| 7 | *B | 20 | *C |
| 8 | Inner screen | 21 | D |
| 9 | Reserved | 22 | *D |
| 10 | EnDat_CLK | 23 | *EnDat_DAT |
| 11 | Reserved | 24 | Inner screen |
| 12 | *EnDat_CLK | 25 | –Temp |
| 13 | +Temp | – | – |

| Cable | Order No. |
|---|---|
| Incremental motor encoder | **6FX□ 002-2CA31-1□□0** |
| Absolute motor encoder (EnDat) | **6FX□ 002-2EQ10-1□□0** |

### *Assignment of X411/X412 for resolvers*

Connector type: 25-pin D-Sub, plug connector

| Pin | Signal name | Pin | Signal name |
|---|---|---|---|
| 1 | Reserved | 14 | Reserved |
| 2 | M_Encoder | 15 | Reserved |
| 3 | SIN_PLUS | 16 | Reserved |
| 4 | SIN_MINUS | 17 | Reserved |
| 5 | Inner screen | 18 | Reserved |
| 6 | COS_PLUS | 19 | Reserved |
| 7 | COS_MINUS | 20 | Reserved |
| 8 | Inner screen | 21 | Reserved |
| 9 | Excitation_Pos | 22 | Reserved |
| 10 | Reserved | 23 | Reserved |
| 11 | Excitation_Neg | 24 | Inner screen |
| 12 | Reserved | 25 | Temp– |
| 13 | Temp+ | – | – |

| Cable | Order No. |
|---|---|
| Resolver in the motor | **6FX□ 002-2CF02-1□□0** |

1) I = Input.

## SIMODRIVE 611 universal plug-in unit

### *Drive-specific terminals*

The drive-specific terminals are available for both drive A and drive B.

| Terminals Drive A No. | Terminals Drive A Designation | Terminals Drive B No. | Terminals Drive B Designation | Function | Type[1] | Technical data | |
|---|---|---|---|---|---|---|---|
| **Analog outputs (X441)** | | | | | | | |
| 75.A | X441.1 | – | – | Analog output 1[2] | AO | Connector type: | 5-pin connector |
| 16.A | X441.2 | – | – | Analog output 2[2] | AO | Wiring: | refer to[3] |
| – | – | 75.B | X441.3 | Analog output 1[2] | AO | Max. conductor cross-section for finely-stranded or solid conductors: | 0.5 mm²/AWG 20 |
| – | – | 16.B | X441.4 | Analog output 2[2] | AO | | |
| 15 | X441.5 | 15 | X441.5 | Reference | – | Voltage range: | –10 to +10 V |
| | | | | | | Maximum current: | 3 mA |
| | | | | | | Resolution: | 8 bit |
| | | | | | | Update: | in the speed controller clock cycle |
| | | | | | | Short-circuit proof | |
| **Terminals for analog inputs and digital inputs/outputs (X451, X452)** | | | | | | | |
| | **X451** | | **X452** | | | Connector type: | 10-pin plug connector |
| | | | | | | Max. conductor cross-section for finely-stranded or solid conductors: | 0.5 mm² |
| 56.A | X451.1 | 56.B | X452.1 | Analog input 1 | AI | Differential inputs | |
| 14.A | X451.2 | 14.B | X452.2 | Reference 1 | AI | Voltage range (limit values): | –12.5 V to +12.5 V |
| 24.A | X451.3 | 24.B | X452.3 | Analog input 2 | AI | Input resistance: | 100 kΩ |
| 20.A | X451.4 | 20.B | X452.4 | Reference 2 | AI | Resolution: | 14 bits (sign + 13 bits) |
| | | | | | | Wiring: | Connect the cable with the braided screen at both ends |
| 65.A | X451.5 | 65.B | X452.5 | Controller enable drive-specific | I | Current drain, typical: | 6 mA at 24 V |
| | | | | | | Signal level (including ripple)<br>High signal level:<br>Low signal level: | <br>15 V to 30 V<br>–3 V to 5 V |
| | | | | | | Electrical isolation: | Reference is terminal 19/terminal M24 |
| 9 | X451.6 | 9 | X452.6 | Enable voltage (+24 V) | V | Reference: | T. 19 |
| | | | | | | Maximum current (for the total group): | 500 mA |
| | | | | | | **Note:** The enable voltage (terminal 9) can be used to provide the enable signals (e.g. controller enable). | |
| I0.A | X451.7 | I0.B | X452.7 | Digital input 0[2]<br>Fast input[3]<br>e.g. for equivalent zero mark, external block change (from SW 3.1) | DI | Voltage:<br>Current drain, typical:<br>Signal level (including ripple)<br>High signal level:<br>Low signal level:<br>Electrical isolation: | 24 V<br>6 mA at 24 V<br><br>15 V to 30 V<br>–3 V to 5 V<br>Reference is terminal 19/terminal M24 |
| I1.A | X451.8 | I1.B | X452.8 | Digital input 1[2] | DI | **Note:**<br>• The parameterization of the input terminals as well as the standard assignment is described in 611 u Function Description<br>• An open-circuit input is interpreted as 0 signal | |
| I2.A | X451.9 | I2.B | X452.9 | Digital input 2[2] | DI | | |
| I3.A | X451.10 | I3.B | X452.10 | Digital input 3[2] | DI | | |

1) AO = Analog output; I = Input; DI = Digital input; AI = Analog input; V = Supply.

2) Can be freely parameterized. All of the digital inputs are de-bounced per software. For the signal detection, this results in a delay time of between 1 and 2 interpolation clock cycles (P1010).

3) I0.x is hardwired internally to the position sensing function where it acts almost instantaneously.

## SIMODRIVE 611 universal plug-in unit

### *Drive-specific terminals*

The drive-specific terminals are available for both drive A and drive B.

| Terminals | | | | Function | Type[1]) | Technical data | |
|---|---|---|---|---|---|---|---|
| Drive A | | Drive B | | | | | |
| No. | Designation | No. | Designation | | | | |
| **Drive-specific terminals (X461, X462)** | | | | | | | |
| | **X461** | | **X462** | | | Connector type: | 10-pin plug connector |
| | | | | | | Max. conductor cross-section for finely-stranded or solid conductors: | 0.5 mm$^2$ |
| A+.A | X461.1 | A+.B | X462.1 | Signal A+ | IO | Incremental angular encoder (WSG/Xset interface, RS485) | |
| A–.A | X461.2 | A–.B | X462.2 | Signal O– | IO | | |
| B+.A | X461.3 | B+.B | X462.3 | Signal B+ | IO | Wiring: | Cable with braided screen connected at both ends |
| B–.A | X461.4 | B–.B | X462.4 | Signal B– | IO | | |
| R+.A | X461.5 | R+.B | X462.5 | Signal R+ | IO | | |
| R–.A | X461.6 | R–.B | X462.6 | Signal R– | IO | | |

**Note:**
The WSG/Xset interface is declared an I/O by appropriate parameterization.

- Input (→ Xset interface, being prepared)
- Output (→ WSG interface, nodes can be connected, which correspond to the RS485/RS422 standard)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| O0.A | X461.7 | O0.B | X462.7 | Digital output 0[2]) | DO | Rated current per output: | 500 mA |
| O1.A | X461.8 | O1.B | X462.8 | Digital output 1[2]) | DO | Maximum current per output: | 600 mA |
| O2.A | X461.9 | O2.B | X462.9 | Digital output 2[2]) | DO | Total current, max. (valid for these 8 outputs): | 2.4 A |
| O3.A | X461.10 | O3.B | X462.10 | Digital output 3[2]) | DO | Voltage drop, typical: | 250 mV at 500 mA |
| | | | | | | Short-circuit proof | |
| | | | | | | **Note:** Parameterization of the output terminals as well as the standard assignment is described in the 611 u Function Description. | |
| | | | | | | Example: If all 8 outputs are simultaneously controlled, then the following is valid: | |
| | | | | | | Σ Current = 240 mA | → O.K. |
| | | | | | | Σ Current = 2.8 A | → not O.K., as the summed current (total current) is greater than 2.4 A. |

**Note:**
- The power switched via these outputs is supplied via terminals P24/M24 (X431). This must be taken into account when dimensioning the external supply.
- The digital outputs only "function" if an external power supply is available (+24 V, T. P24/M24).

## Pin assignment of the interface

### *Assignment of the serial interface*

Connector type: 9-pin D-Sub, socket connector

| Pin | Signal name | Pin | Signal name |
|---|---|---|---|
| 1 | RS485 DATA+ | 6 | Reserved |
| 2 | RS232 T x D | 7 | RS232 CTS |
| 3 | RS232 R x D | 8 | RS232 RTS |
| 4 | Reserved | 9 | RS485 DATA– |
| 5 | Ground 0 V | – | – |

**Note:**
- The serial interface can be declared an RS232 or an RS485 interface by appropriate parameterization.
- When set as an RS485 interface, a terminating resistor can be switched-in/out via switch S1 on the front panel.
- The cable diagrams for the serial interface are provided in Section 2.5.

1) DO = Digital output; IO = Input/output.

2) Freely parameterizable. The digital outputs are updated in the interpolation clock cycle (P1010). A hardware delay time of approx. 200 $\mu$s is added.

## Monitoring module

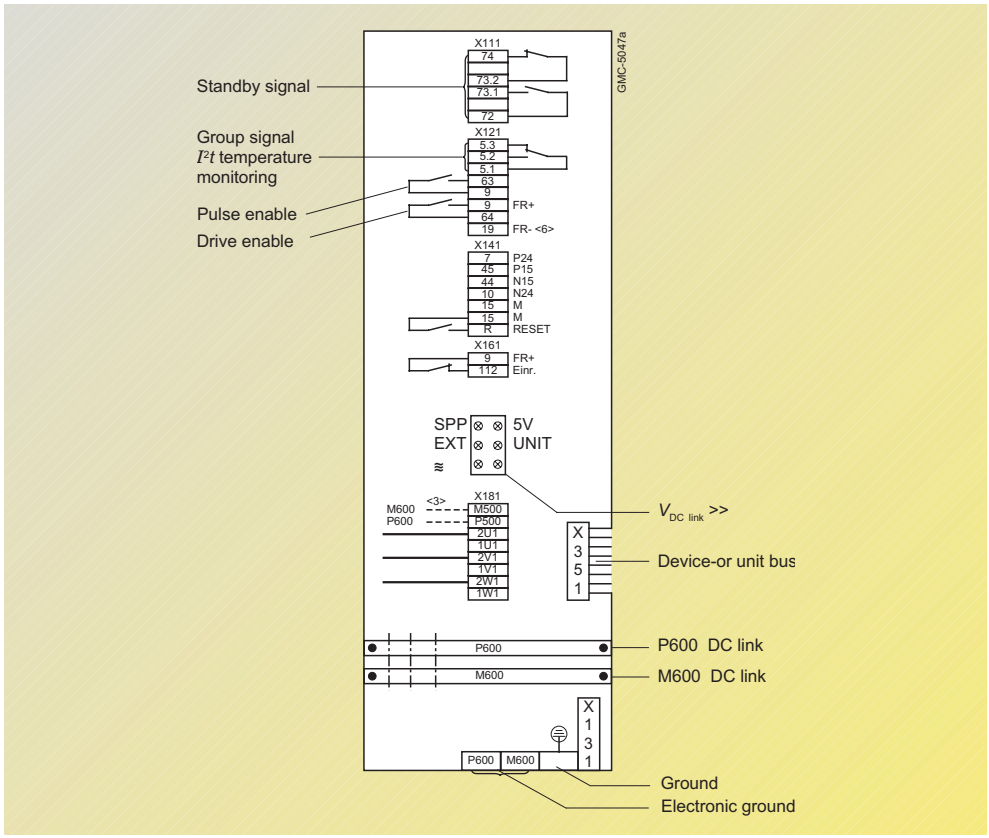



Fig. 6/76

| Terminal No. | Designation | Function | Type[1]) | Typ. voltage/ limit values | Max. cross-section[2]) |
|---|---|---|---|---|---|
| Ground (PE) | | Protective conductor | I | 0 V | Bolt |
| P600 | | DC link | I/O | +300 V | Busbar |
| M600 | | DC link | I/O | –300 V | Busbar |
| | | Grounding bar[4]) | I/O | –300 V | Busbar |
| P600[5]) | | DC link | I | +300 V | 16 mm$^2$/10 mm$^2$ [3]) |
| M600 | | DC link | I | –300 V | 16 mm$^2$/10 mm$^2$ [3]) AWG 6/8 |
| | X131 | Electronics M | I/O | 0 V | 16 mm$^2$/10 mm$^2$ [3]) AWG 6/8 |

1) I = Input; O = Output; NC = NC contact; NO = NO contact; (for signal, NO = high; NC = low).

2) For UL certification, only use copper cables which are designed for a ≥ 60 °C operating temperature.

3) The 1st number is valid for cable lugs. The 2nd number is valid for finely-stranded conductors without connector sleeve.

4) The grounding bar is used to ground the DC link rail through 100 kΩ.

5) Max. permissible connected power $P_{max.}$ ≤ 43 kW, max. permissible current load $I_{max.}$ ≤ 72 A.

## Monitoring module

| Terminal No. | Designation | Function | Type[1]) | Typ. voltage/ limit values | Max. cross-section[2]) |
|---|---|---|---|---|---|
| | X351 | Equipment (Device) bus | I/O | Various | Ribbon cable |
| M500 | X181 | DC link power supply | I | DC –300 V | 1.5 mm²/AWG 16 |
| P500 | X181 | DC link power supply | I | DC +300 V | 1.5 mm²/AWG 16 |
| 1U1 | X181 | Output L1 | O | 3-ph. 400 V AC | 1.5 mm²/AWG 16 |
| 2U1 | X181 | Input L1 | I | 3-ph. 400 V AC | 1.5 mm²/AWG 16 |
| 1V1 | X181 | Output L2 | O | 3-ph. 400 V AC | 1.5 mm²/AWG 16 |
| 2V1 | X181 | Input L2 | I | 3-ph. 400 V AC | 1.5 mm²/AWG 16 |
| 1W1 | X181 | Output L3 | O | 3-ph. 400 V AC | 1.5 mm²/AWG 16 |
| 2W1 | X181 | Input L3 | I | 3-ph. 400 V AC | 1.5 mm²/AWG 16 |
| 7 | X141 | P24 | O | +20.4 ... 28.8 V/50 mA | 1.5 mm²/AWG 16 |
| 45 | X141 | P15 | O | +15 V/10 mA | 1.5 mm²/AWG 16 |
| 44 | X141 | N15 | O | –15 V/10 mA | 1.5 mm²/AWG 16 |
| 10 | X141 | N24 | O | –20.4 ... 28.8 V/50 mA | 1.5 mm²/AWG 16 |
| 15[3]) | X141 | M | O | 0 V | 1.5 mm²/AWG 16 |
| R[5]) | X141 | RESET | I | Term. 15/$R_E$ = 10 kΩ | 1.5 mm²/AWG 16 |
| 5.3 | X121 | Relay contact | NC | 50 V DC/0.5 A/12 VA | 1.5 mm²/AWG 16 |
| 5.2 | X121 | Group signal | NO | max. | 1.5 mm²/AWG 16 |
| 5.1 | X121 | $I^2$t/motor temp. | I | 5 V DC/3 mA min | 1.5 mm²/AWG 16 |
| 63[3]) | X121 | Pulse enable | I | | 1.5 mm²/AWG 16 |
| 9[3])[4]) | X121 | Enable voltage | O | +13 V ... 30 V/$R_E$ = 1.5 kΩ | 1.5 mm²/AWG 16 |
| 9[3])[4]) | X121 | Enable voltage | O | +24 V | 1.5 mm²/AWG 16 |
| 64[3]) | X121 | Drive enable | I | +24 V | 1.5 mm²/AWG 16 |
| 19 | X121 | Enable voltage, reference potential | | +13 V ... 30 V/$R_E$ = 1.5 kΩ<br>0 V | 1.5 mm²/AWG 16 |
| 74 | X111 | | NC | | 1.5 mm²/AWG 16 |
| nc | X111 | | | | 1.5 mm²/AWG 16 |
| 73.2 | X111 | Relay contact | I | 1-ph. 250 V AC/50 V DC/2 | 1.5 mm²/AWG 16 |
| 73.1 | X111 | Ready signal | I | A max. | 1.5 mm²/AWG 16 |
| nc | X111 | | | 5 V DC/3 mA min | 1.5 mm²/AWG 16 |
| 72 | X111 | | NO | | 1.5 mm²/AWG 16 |
| 9[3])[4]) | X161 | Enable voltage | O | +24 V | 1.5 mm²/AWG 16 |
| 112[3]) | X161 | Setting-up mode/ Standard mode | I | +21 V ... 30 V/$R_E$ = 1.5 kΩ | 1.5 mm²/AWG 16 |

1) I = Input; O = Output; NC = NC contact; NO = NO contact; (for signal, NO = high; NC = low).

2) For UL certification, only use copper cables which are designed for a ≥60 °C operating temperature.

3) Terminal 19 is the reference ground (connected inside the module with 10 kΩ to the general reference ground X131/terminal 15). It is not permissible that terminal 15 is connected to PE or terminal 19, further, no external voltage sources may be connected to terminal 15. Terminal 19 may be connected to X131. The terminal may only be used to enable the associated drive group.

4) Maximum current load of terminal 9 with respect to 19: 0.5 A.

5) RESET = Resets the error memory, edge triggered for the complete drive group (Terminal "R" → Terminal 15 = RESET).

## Pulsed resistor module

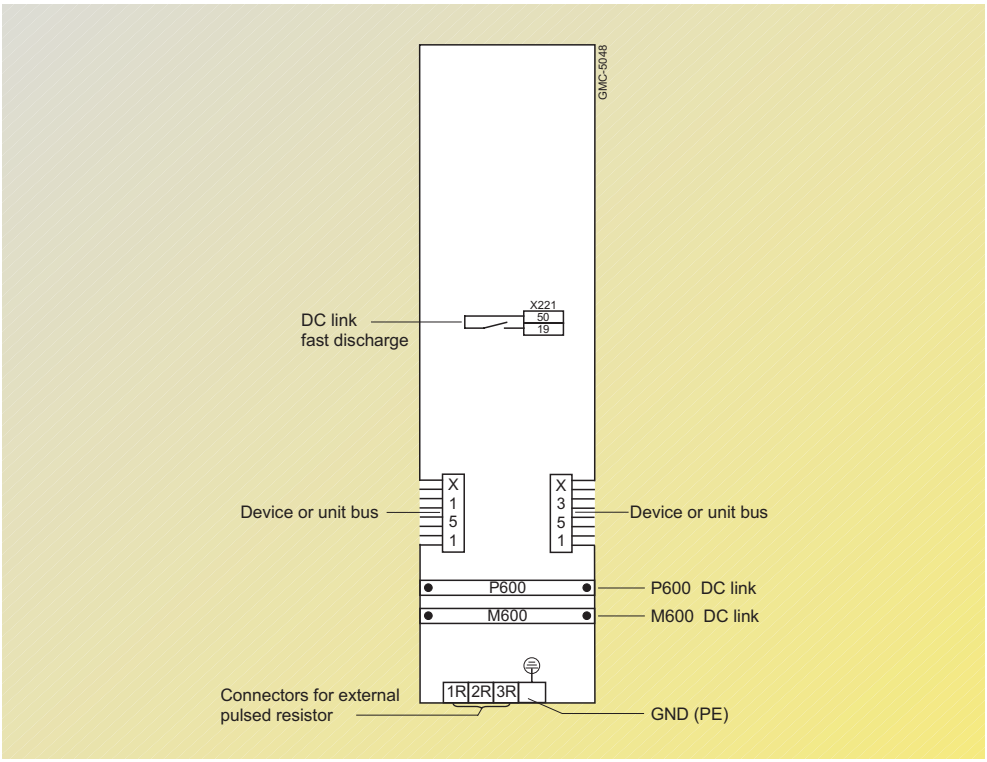



Fig. 6/77

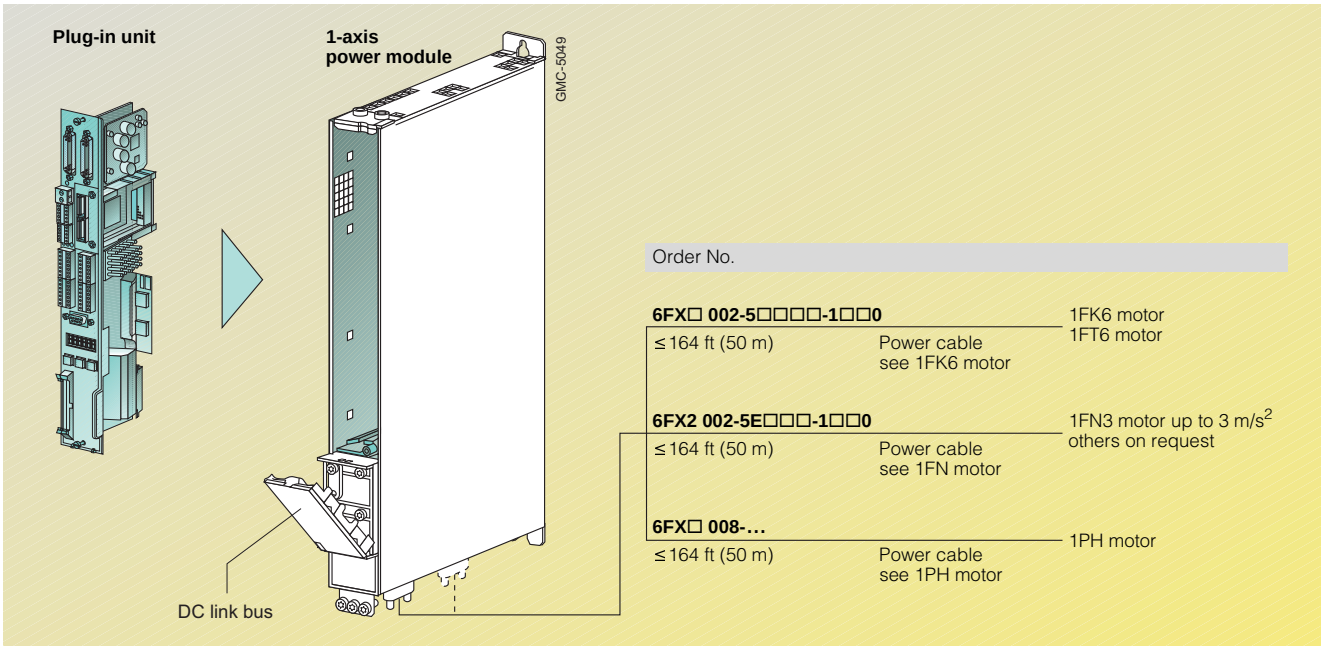
| Terminal No. | Designation | Function | Type[1]) | Typ. voltage/ limit values | Max. cross-section |
|---|---|---|---|---|---|
| | X151 | Equipment (Device) bus | I/O | Various | Ribbon cable |
| 19 | X221 | Enable voltage, reference potential | O | 0 V | 1.5 $mm^2$/AWG 16 |
| 50 | X221 | Control contact for fast discharge | E | 0 V | 1.5 $mm^2$/AWG 16 |
| Ground (PE) | | Protective conductor | I | 0 V | Bolt |
| P 600 | | DC link | I/O | +300 V | Busbar |
| M 600 | | DC link | I/O | –300 V | Busbar |
| 1 R<br>2 R<br>3 R | TR1<br>TR2 2) | External resistance connection | I/O | V 300 | 6 $mm^2$/4 $mm^2$ 3)<br>AWG 10/12 |

1) I = Input; O = Output.

2) Only for O/I 28 kW.

3) The 1st number is valid for cable lugs. The 2nd number is valid for finely-stranded conductors without connector sleeve.

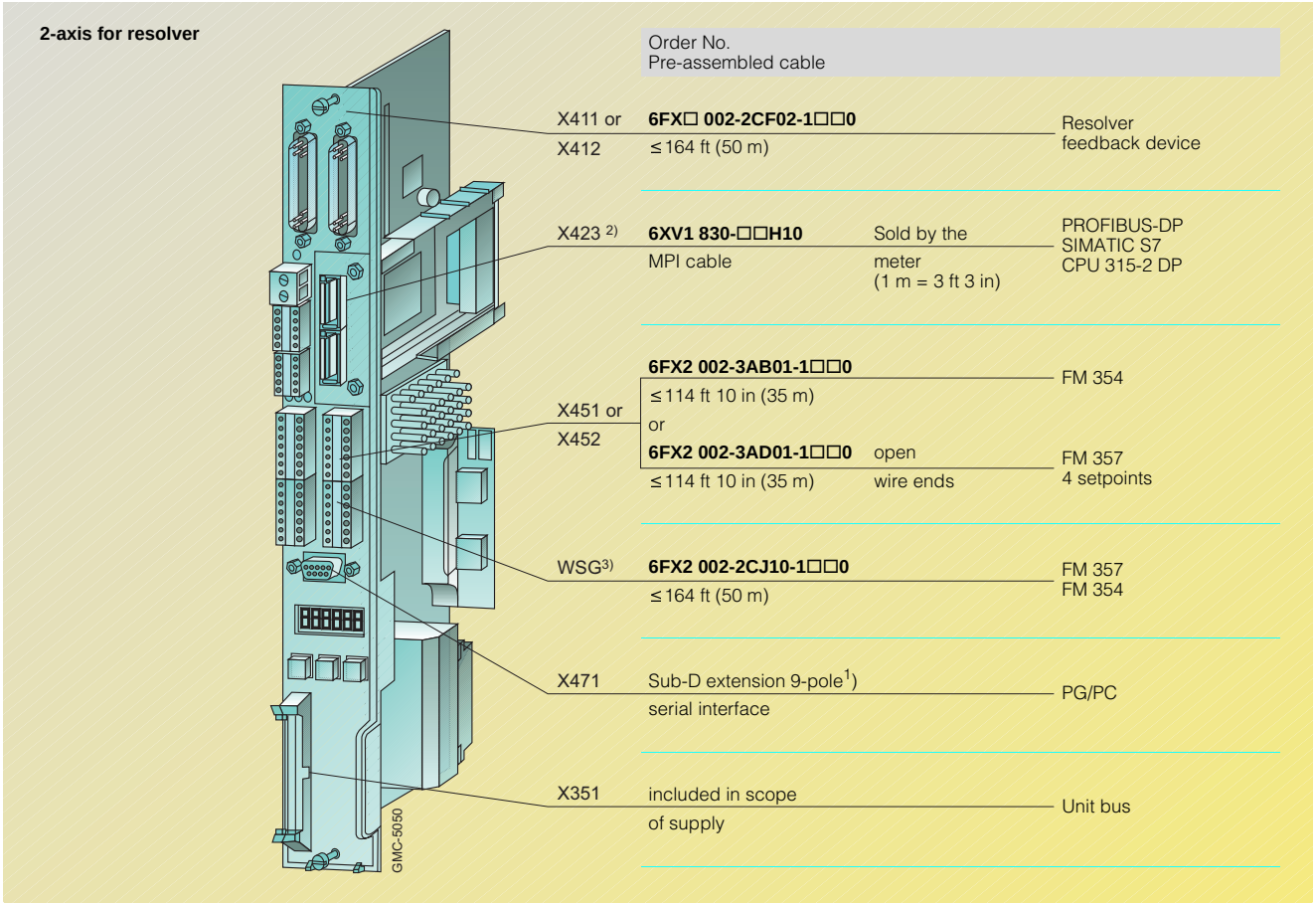
## 1- or 2-axis power module




| Order No. | | |
|---|---|---|
| **6FX□ 002-5□□□□-1□□0** | | 1FK6 motor<br>1FT6 motor |
| ≤ 164 ft (50 m) | Power cable see 1FK6 motor | |
| **6FX2 002-5E□□□-1□□0** | | 1FN3 motor up to 3 m/s$^2$<br>others on request |
| ≤ 164 ft (50 m) | Power cable see 1FN motor | |
| **6FX□ 008-…** | | 1PH motor |
| ≤ 164 ft (50 m) | Power cable see 1PH motor | |

Fig. 6/78

## Plug-in unit with resolver



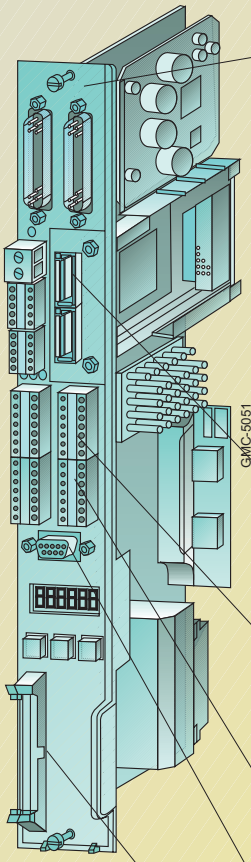

| Order No.<br>Pre-assembled cable | | |
|---|---|---|
| X411 or X412 | **6FX□ 002-2CF02-1□□0**<br>≤ 164 ft (50 m) | Resolver feedback device |
| X423 [2] | **6XV1 830-□□H10**<br>MPI cable<br>Sold by the meter (1 m = 3 ft 3 in) | PROFIBUS-DP SIMATIC S7 CPU 315-2 DP |
| X451 or X452 | **6FX2 002-3AB01-1□□0**<br>≤ 114 ft 10 in (35 m)<br>or | FM 354 |
| | **6FX2 002-3AD01-1□□0**<br>≤ 114 ft 10 in (35 m)<br>open wire ends | FM 357<br>4 setpoints |
| WSG[3] | **6FX2 002-2CJ10-1□□0**<br>≤ 164 ft (50 m) | FM 357<br>FM 354 |
| X471 | Sub-D extension 9-pole[1])<br>serial interface | PG/PC |
| X351 | included in scope of supply | Unit bus |

Fig. 6/79

1) PC accessory.
2) At the optional PROFIBUS interface.
3) Incremental angular encoder.

## Plug-in unit with optical sin/cos encoder

**2-axis for encoder with sin/cos 1 $V_{pp}$**




Order No.
Pre-assembled cable

| | | | |
|---|---|---|---|
| | **6FX2 002-1AA14-1A□0**<br>≤ 16 ft 5 in (5 m)<br>(3 ft 3 in, 6 ft 7 in, 16 ft 5 in [1 m, 2 m, 5 m]) | Open<br>wire ends | Temperature sensor in 1FN motor[1]) |
| X411 or X412 | **6FX□ 002-2CH00-1□□0**<br>≤ 164 ft (50 m) | Adapter cable[2])<br>313 791 .. | Linear absolute measuring system (ENDat)<br>LC 181 |
| | **6FX2 002-2CG00-1□□0**<br>≤ 164 ft (50 m) | Adapter cable[2])<br>310 128 ..<br>310 123 .. | Linear incremental measuring system<br>LS 186 (C)<br>LS 486 (C) |
| | **6FX□ 002-2EQ10-1□□0**<br>≤ 164 ft (50 m) | | Motor encoder absolute;<br>EQN |
| | **6FX□ 002-2CA31-1□□0**<br>≤ 164 ft (50 m) | | Motor encoder SIMAG H |
| | **6FX□ 002-2CA31-1□□0**<br>≤ 164 ft (50 m) | | Motor encoder incremental;<br>ERN |
| X423 4) | **6XV1 830-□□H10**<br>MPI cable | Sold by<br>the meter | PROFIBUS-DP<br>SIMATIC S7<br>CPU 315-2 DP |
| X451 or X452 | **6FX2 002-3AB01-1□□0**<br>≤ 114 ft 10 in (35 m)<br>or<br>**6FX2 002-3AD01-1□□0**<br>≤ 114 ft 10 in (35 m) | Open<br>wire ends<br>Open<br>wire ends | FM 354<br>FM 357<br>4 setpoints |
| WSG5) | **6FX2 002-2CJ10-1□□0**<br>≤ 164 ft (50 m) | | FM 357<br>FM 354 |
| X471 | Sub-D extension 9-pole3)<br>serial interface | | PG/PC |
| X351 | included in scope of supply | | Unit bus |

Fig. 6/80

1) The temperature sensor must be connected by the customer. The cables for the temperature sensor are included in the 6FX2 002-5E ... power cable for the 1FN motor.

2) Cable can be obtained from the manufacturer of the linear scale.

3) PC accessory.

4) At the optional PROFIBUS interface.

5) Incremental angular encoder.

## General information

The SIMODRIVE 611 drive converter system is designed for a rated voltage of 300 V between the phase and the grounded neutral point.

It is not permissible that this voltage is exceeded, as otherwise the drive converter insulation system could be damaged and in turn inadmissibly high touch voltages can occur.

**Important!**

The drive converters may only be connected directly to TN line supplies or via an auto-transformer.
For all other line supply types, an isolating transformer must be connected in series with the neutral point grounded on the secondary side.

***Note***

UL requirement for the maximum line supply short-circuit current:

Infeed units up to a rated output of 37.3 kW:
May only be connected to line supplies with a maximum short-circuit current of 5 kA RMS symmetrical, for a 480 V AC line supply voltage.

Infeed units up to a rated output of 39 kW:
May only be connected to line supplies with a maximum short-circuit current of 10 kA RMS symmetrical, for a 480 V AC line supply voltage.

## Example TN-C line supply network

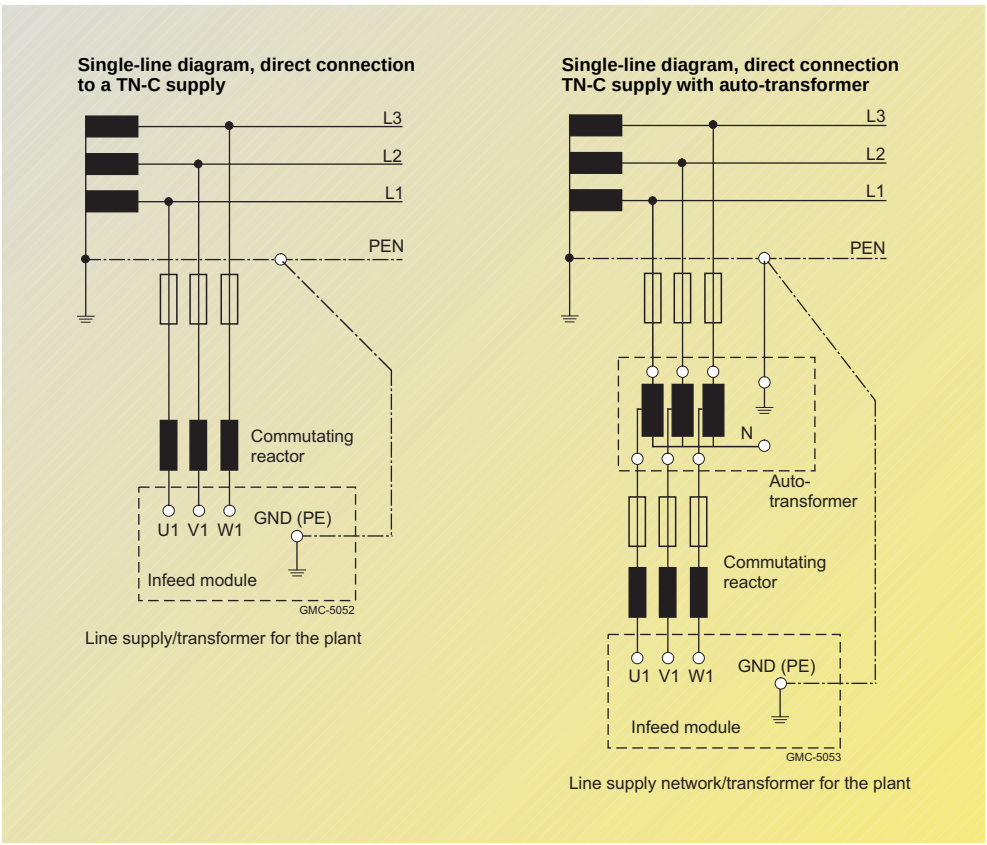



Fig. 6/81
Single-line diagram TN-C line supply networks

***Connection types***

It is possible to connect the drive converter directly to a TN line supply network for 3-ph. 400 V AC, 3-ph. 415 V AC, 3-ph. 480 V AC[1]). For other voltage levels, it is possible to connect the drive converter through an auto-transformer.

***Note***

When using auto- or isolating transformers in front of infeed modules (module width ≥100 mm) an overvoltage limiting module, Order No.: 6SN1 11-0AB00-0AA0 or an external voltage limiting circuit must be used.

***Description of TN-C supply, TN-S supply, TN-C-S supply***

Symmetrical 4-conductor or 5-conductor three-phase line supply network with grounded neutral point which can be loaded, with a protective and neutral conductor connected to the neutral point – depending on the line supply type, using one or several phases.

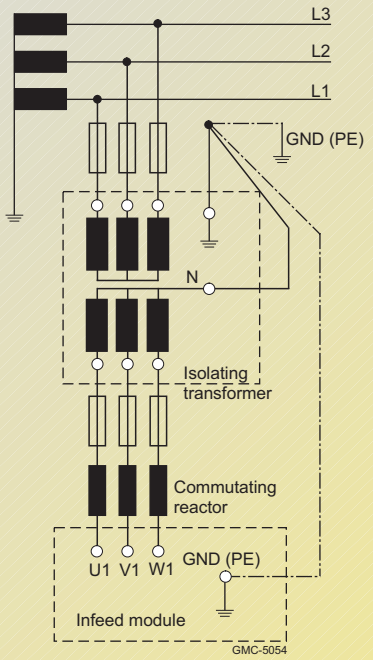
For other line supply network types, the infeed module must be connected via an insulating transformer as shown in the examples on these pages.

1) 480 V direct connection is only possible in conjunction with the following power modules (Order No. 6SN11 2□-1□□0□-0□□1) and I/RF modules Order No.: 6SN11 4□-1□□0□-0□□1.

For motors with shaft height < 100: Utilization up to max. 60 K temperature values acc. to the General Motion Control Catalog Part 2. Please observe the Engineering Manual for Motors.

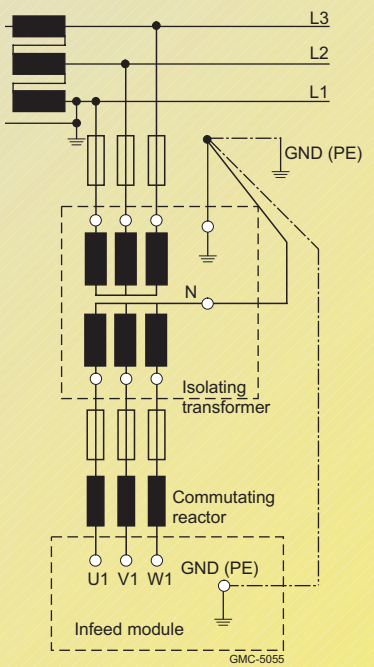
## Example TT line supply network

**Single-line diagram TT line supply network with grounded neutral point and isolating transformer**




Line supply/transformer for the plant

**Single-line diagram TT line supply network, grounded phase and isolating transformer**




Line supply/transformer for the plant

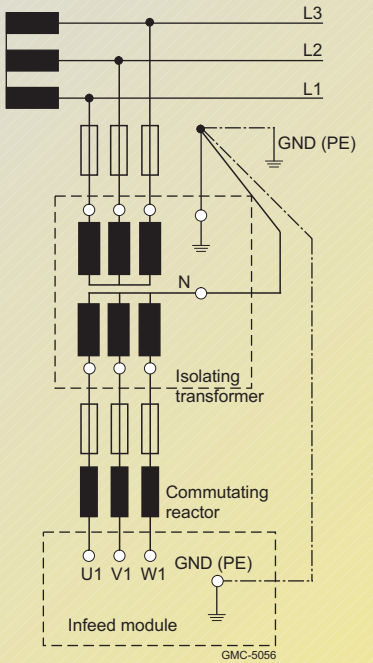
Fig. 6/82
Single-line diagram TT line supply networks

### *Description of TT supply*

Symmetrical 3-conductor or 4-conductor three-phase line supply network with a directly grounded point, the loads are, for example, connected with ground, which are not electrically connected with the directly grounded point of the line supply network.

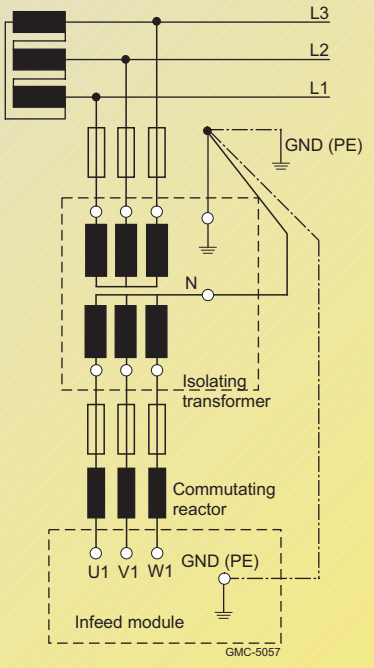
## Example IT line supply network

**Single-line diagram IT line supply network and isolating transformer**




Line supply/transformer for the plant

**Single-line diagram IT line supply network and isolating transformer**




Line supply/transformer for the plant

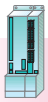
Fig. 6/83
Single-line diagram IT line supply networks

### *Description of IT supply*

Symmetrical 3-conductor or 4-conductor three-phase line supply network without a directly grounded point, i.e. the loads are, for example, connected with ground connections.

### *Note*

When using isolating transformers in front of I/RF (aka. I/R) and O/I (aka. U/E) modules (module width ≥ 100 mm), an overvoltage limiting module, Order No.: 6SN11 11-0AB00-0AA0 or an external voltage limiting circuit must be used. For O/I (aka. U/E) 5 kW, Order No. 6SN11 46-2AB00-0BA1 a voltage limiting circuit is included.



SIMODRIVE 611 universal

## Electromagnetic compatibility (EMC)

EMC stands for electromagnetic compatibility and, according to the definition of the EMC law, describes the "ability of a device to function satisfactorily in an electromagnetic environment without itself causing electromagnetic interference which is unacceptable for other devices in this environment." In order to ensure that the relevant EMC standards are complied with, the devices must demonstrate a sufficiently high immunity to interference, on the one hand, and interference emission must be limited to compatible values, on the other.

**The product standard, EN 61 800-3,** relevant to "variable-speed drives" describes the requirements for residential and industrial environments.

### *Immunity to interference*

The units satisfy the requirements of the EMC product standard, EN 61 800-3, for industrial environments and thus the lower values regarding immunity to interference required by the residential environment as well.

### *Interference emission and radio-interference suppression*

If converters are used in a residential area, conducted interference or radiated interference must not exceed the limit values according to class "B1" in accordance with the European standard EN 55 011.

| Type of interference | Level of interference | Comments |
|---|---|---|
| Electrostatic Discharge (ESD) | up to 12 V | |
| Fast transient interference (bursts) | up to 4 kV | for power section |
| | up to 2 kV | for signal cables |

A residential area in this sense is a connection, i.e. an outgoing section of a transformer, to which private households are also connected.

The EMC law requires that an industrial system as a whole is electromagnetically compatible with its environment.

In the case of units for use in industrial environments, no limit values are defined for emitted interference.

If the SIMODRIVE units are to comply with limit values, the following must be provided:

- Radio-interference suppression filters, including the commutating reactors for reducing the cable-fed interference
- Screened cables for motor supply lines and signal lines for reducing electromagnetically emitted interference
- Compliance with the installation guidelines.

In systems with SIMODRIVE units and other components, e.g. contactors, switches, evaluation units, automation units etc., it must be ensured that no interference is emitted to the outside and also that the individual units do not cause interference among themselves. In this respect, the measures described in the brochure, Design of Drives in Conformance with EMC Regulations contained in the Planning Guide should be followed.

The most important of these measures are summarized here:

- The components of a system must be housed in a cabinet which acts like a Faraday cage.
- Signal lines and motor supply cables must be screened. The screens must be connected to earth at both ends.
- Signal cables should be spatially separated (at least 8 in (20 cm)) from the power cables. If necessary, screening plates are to be provided.

## Overview

Technology functions software of SIMODRIVE 611 universal Motion Control units

### *Operating mode speed/ torque setpoint*

- Closed-loop current and speed control
- Ramp-function generator
- Optimizing the closed-loop current and speed controller
- Speed controller adaptation
- Fixed speed setpoint (from SW 3.1)
- Monitoring functions
- Limits

### *Positioning mode (from SW 2.1)*

- Traversing range: ± 656.2 ft (± 200 m)
- Traversing speed: 0.001 up to 2000 m/min
- Acceleration/deceleration: 0.001 up to 999.999 m/s$^2$
- Number of program blocks: 64
- Encoder adaptation
- Travel, velocity and acceleration
- Closed-loop position control
- Referencing
- Adjustment for absolute motor measuring systems
- Parameter overview when referencing/adjusting
- Jogging
- Programming traversing blocks
- Starting, interrupting and aborting traversing blocks

### *Miscellaneous functions*

- V/Hz operation (diagnostics function)
- V/Hz operation with induction motor (ARM)
- V/Hz operation with synchronous motor (SRM)
- Motor data optimization
- Motor holding brake
- Angular incremental encoder/ Xset interface (X461, X462)
- Torque/power reduction via terminal 24.x/20.x
- Motor changeover for induction motors (from SW 2.4)
- Parameter set changeover

## Encoders for position detection

SIMODRIVE 611 universal allows position detection directly via the motor encoder so that an additionally built-on encoder is not needed for position control. Only when it is necessary from a technological point of view can position detection take place by means of an additional external encoder. The types of encoder can be classified as absolute-value encoders.

### *Absolute-value encoders*

can be divided up into two groups:

Single-turn encoders (two-pole resolver, optical sine/cosine encoder) supply the absolute position within a revolution.

If absolute positions have to be detected over several revolutions with a single-turn encoder (normal occurrence), referencing is necessary as with the incremental encoder.

Multiturn encoders detect the position within a revolution and over a defined range (e.g. 4096 revolutions) and supply this value when the system is restarted after a power failure. Referencing is thus not necessary.

- Please note that with a 2-axis control board, it is **not possible** to **mix encoders** with sin/ cos 1 Vpp and resolvers.
- Third-party encoders can also be connected.

Overview of the characteristics of the different encoders:

| Encoder type | Resolution (increments/revolution) | Achievable positioning accuracy ❶ (pulses/revolution) |
|---|---|---|
| Resolver ❷ | 4096 pulses/rev with 2-pole resolver | 1024 pulses/rev with 2-pole resolver |
| Sine/cosine encoder ERN 1387 | 65,535 pulses/rev | $10^5$ pulses/rev |
| Absolute-value encoder EQN 1325 | 65,535 pulses/rev | $10^5$ pulses/rev |

### Notes

❶ In practice, the resolution of the encoder must be higher than the requested positioning accuracy by a factor of 4 to 10. The levels of accuracy given in the table are only rough guidelines.

❷ Resolver:

- In the case of multiple-pole resolvers, the resolution and accuracy is correspondingly higher.
- In the following cases, an ERN 1387 sine/cosine encoder should be used instead of a resolver:
  - for extreme requirements regarding positioning accuracy
  - for extreme requirements regarding the dynamic response
  - when printing indices are to be detected with a high degree of accuracy
  - when smooth running characteristics are required at extremely low speeds under approx. 5 rpm.

## Integration in SIMATIC automation systems

The PC can be connected to the PLC via MPI (always necessary for the initial setup) or via PROFIBUS-DP (up to 12 Mbps, PCMCIA card CP 5511 for notebooks or PCI card CP 5611 for desktops are required).

### *Profibus-DP3 module*

With this technology the synchronization of axis via PROFIBUS-DP is available. To talk PROFIBUS-DP3 a PLC S7 315-2AF03 or 318-2AJ00 or newer is required. The SIMODRIVE 611u has to have Firmware 02.05.9 (shown in SimoComU Diagnostics/Firmware version) or higher. The use of the Totally Integrated Automation Software DRIVE ES Basic is recommended.

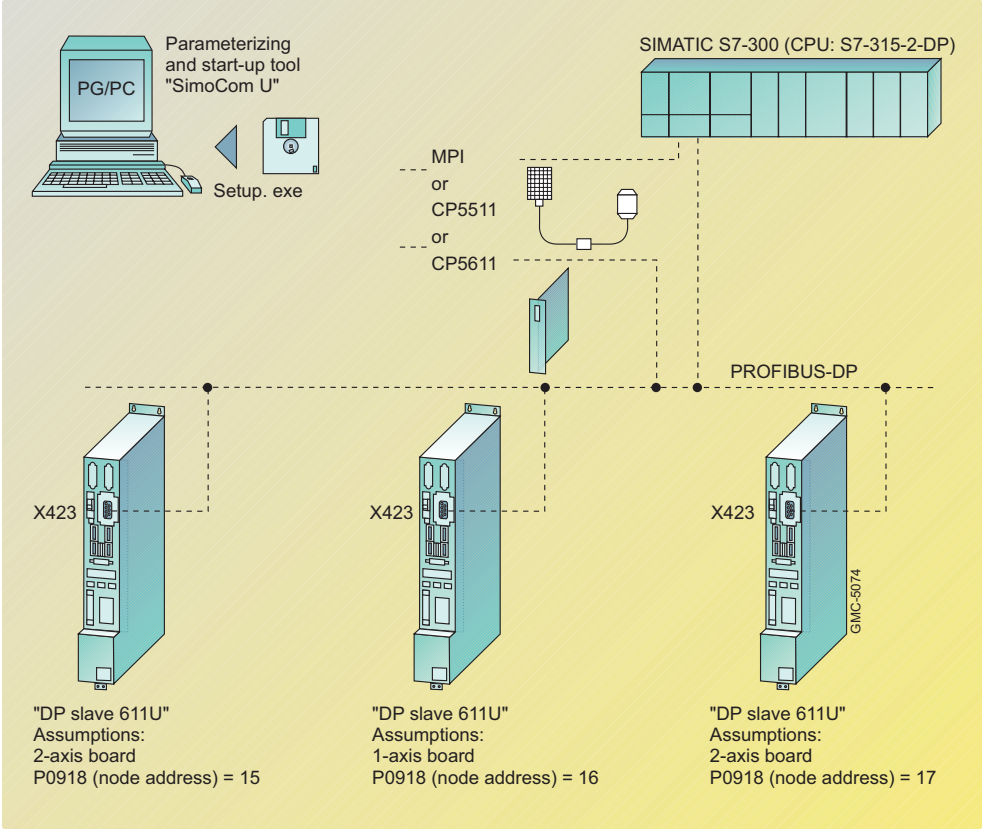



Fig. 6/84
Integration in SIMATIC automation systems

## Centralized option boards

Siemens supplies “scalable technology functions” for Motion Control.

The SIMODRIVE 611 universal already has a wide range of functions “on board”. In order to extend these functions, the SIMODRIVE 611 universal units can be flexibly linked up to central systems. Some central solutions can be configured graphically with the CFC. This enables simple and rapid customized planning and adaptation.

| Designation | Order No. | Properties |
|---|---|---|
| **PROFIBUS-DP3** | **6SN11 14-0NB01-0AA0** | • PROFIBUS-ASIC DPC31 with PLL<br>• “Motion Control with PROFIBUS-DP” function (clock-synchronous PROFIBUS operation) is possible |
| **Features which PROFIBUS-DP3 has** | | • Prerequisite: Control board from SW 3.1 is required<br>• Cyclic data transfer (PKW and PZD parts) possible<br>• FW module can be updated using SimoCom U<br>• Non-cyclic data transfer (DP/V1)<br>• “SimoCom U via PROFIBUS” possible |
| **Terminal module** | **6SN11 14-0NA00-0AA0** | • 8 digital inputs and outputs<br>• freely parameterizeable<br>• permanently assigned to axis A |

The link can be established in any of the following ways:

- Fieldbus systems (PROFIBUS-DP)
  - Transmission of setpoints, actual values, control words and parameters
- Analog input on SIMODRIVE 611 universal ± 10 V
  - The standard resolution of the analog input is 14 bits

The following table provides an overview of the centralised option boards and their functionality.

## Control terminal strip

The control terminal strip is located on the front of the plug-in unit.

All the necessary functions for operating and monitoring SIMODRIVE 611 universal-DRIVES are accessible via the control terminal strip.

- Control commands, e.g. enable signals, ON/OFF, operating conditions, block selection, setpoint selection, operation modes etc.
- Analog setpoint inputs, e.g. speed setpoint, torque setpoint
- Analog outputs of internally calculated quantities, e.g. motor current, speed, motor voltage, frequency
- Status messages, e.g., run, fault.

For the assignment of the control terminal strip, please refer to the 611 u Function Description

## Start-up, parameterization and diagnostics with SimoCom U

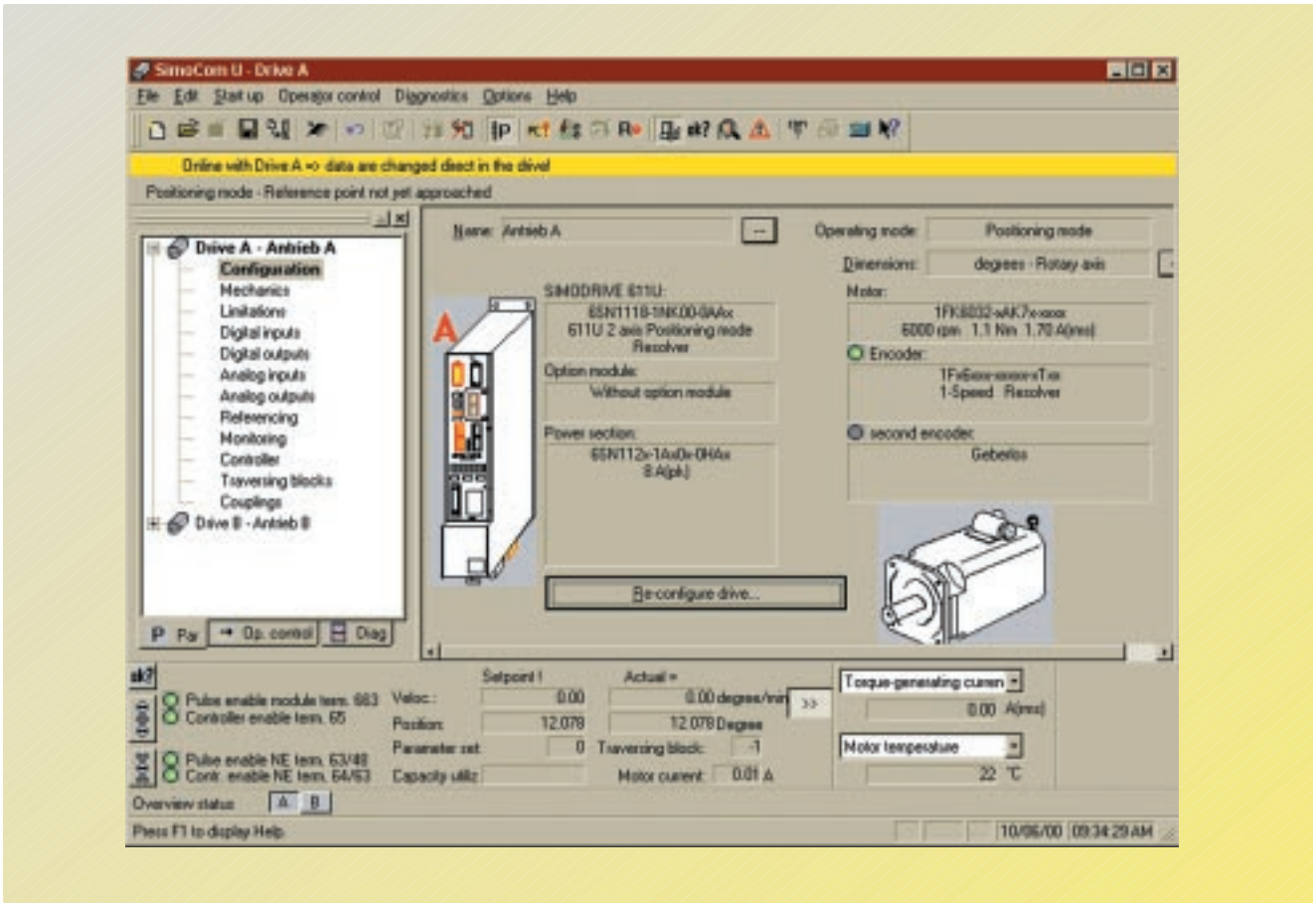



Fig. 6/85
Work window of SimoCom U

### *SimoCom U performance charcteristics*

- Setting and monitoring of all basic-units parameters in tables which can be individually created
- Reading, writing, managing, printing and comparison of parameter sets
- Handling of process data (control commands, setpoints)
- Diagnostics (faults, alarms, fault memory)
- Off-line and on-line operation
- Drive can be operated from the PC
- Automatic speed controller-self-optimization using FFT analysis
- Function generator/oscilloscope function “on board”
- Very simple handling!

### *PC configuration (hardware and software requirements)*

- Windows 95, 98 or Windows NT
- ≥ 32 MByte RAM
- Free hard-disk memory: 15 MByte
- Screen resolution: 800 x 600 or higher

For stand-alone operation (USS)

- RS232 serial interface

For use with SIMATIC S7/ PROFIBUS-DP

- CP5511 or CP 5611 communication board

## Integrating drives in SIMATIC S7 with Drive ES

The engineering and process control of SIMODRIVE in combination with a SIMATIC S7 and STEP™ 7 ≥ V 5.0 is particularly user friendly and convenient.

If the optional Software Drive ES (Drive Engineering System) is installed on the same software platform (PC or PG) then the engineering of the complete system can take place via the STEP 7 Manager. Data transportation is handled by the S7 system bus PROFIBUS-DP (see Fig. 6/86).

The optional software Drive ES combines the previously individual steps of configuring (hardware configuring, parameter assignment, technology functions) and the control functions between SIMATIC S7 and SIMODRIVE, in one software tool.

Fully integrated in the STEP 7 Manager, Drive ES consists of two components with different functions.

Drive ES Basic is used for convenient startup and for servicing and diagnostics during operation of the plant. The great advantage is in the system-wide data management of drive and automation data of a project in the STEP 7 Manager, as well as the use of the complete communication possibilities of SIMATIC S7. This includes e.g. the communication by Routing.

Drive ES SIMATIC makes available the functionality of the software DVA_S7 for STEP 7 ≥ V 5.0. The communication between SIMATIC S7 and Siemens drives (e.g. SIMODRIVE) can then be configured using preconfigured CPU function blocks and simple parameter assignment.

In joint operation with the PROFIBUS communication board DP-3, Drive ES supports additional functionalities such as slave-to-slave communication between drives and flexible configuration of the cyclic messages.

In Drive ES Basic the drive SIMODRIVE 611 universal is represent via SimoCom U in march 2001. The POSMO A is represented via PosVis in april 2001.

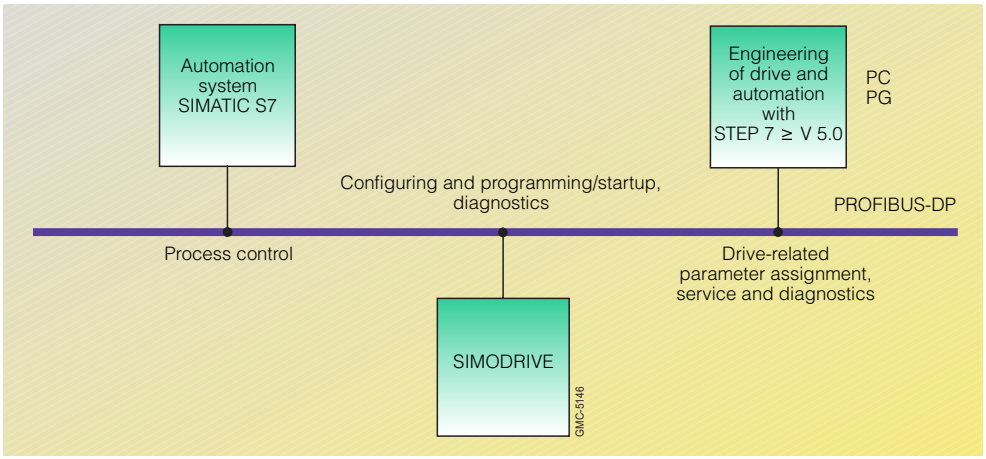



Fig. 6/86
Integration of SIMODRIVE in the SIMATIC S7 automation system

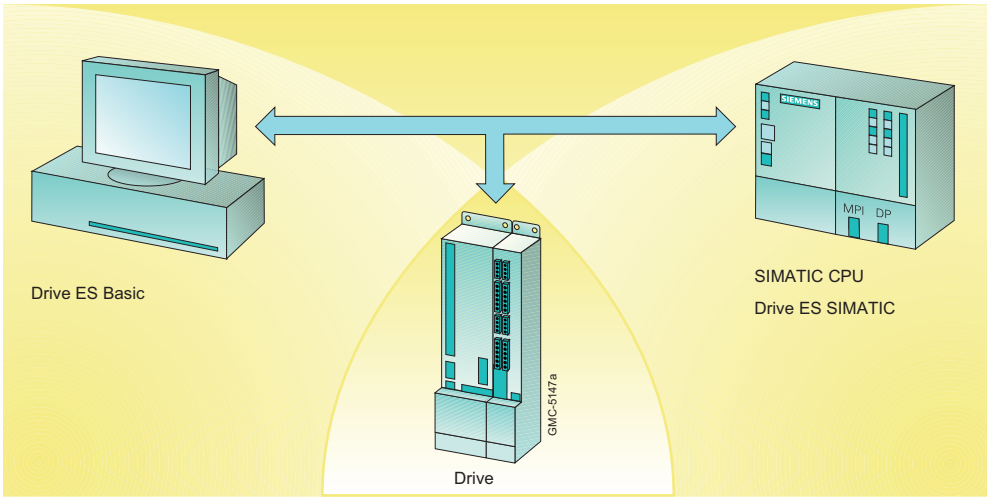



Fig. 6/87
Object distribution of the Drive ES packages

## Ordering Data

| Scope of supply | Order No. | Supplies as | Documentation |
|---|---|---|---|
| **Optional software Drive ES** | | | |
| **Drive ES Basic V 5.0**<br>Single license | **6SW1700–0JA00–0AA0** | CD-ROM<br>1 piece | German/English |
| **Drive ES SIMATIC**<br>Single license | **6SW1700–0JC00–0AA0** | CD-ROM<br>1 piece | German/English |

## SimoSize

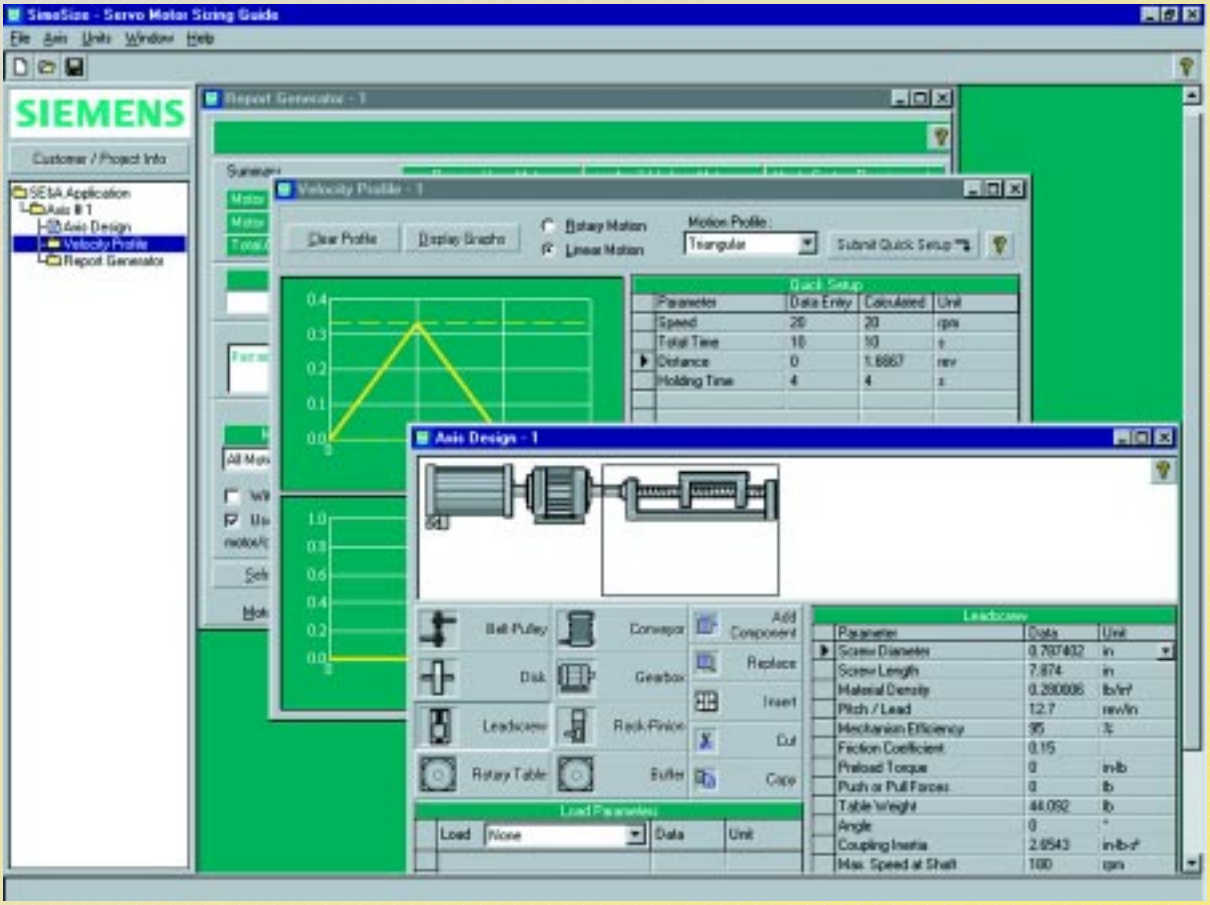



Fig. 6/88
Work window of SimoSize

SimoSize is a PC tool which allows the user to accelerate the motion Design cycle by providing all the necessary tools and products in a modern graphical interface format using Windows 95/98/NT.

SimoSize is available free of charge and may be copied and distributed anytime.

SimoSize offers the following range of functions:

1. Axis Design allows the quick selection of components like gearboxes, leadscrews, etc. just by clicking on the appropriate button and inputting the required data.
2. Velocity Profile allows specifying and refining the profile to your application needs.
3. Report Generator provides the results of all the calculation performed for speed, torque and inertia required to properly select a motor. This process is further simplified with the “Auto Select” button. “Auto Select” will find the optimum choice for you automatically according to the selected parameters and motor requirements.

The following components are available together with the SIMODRIVE POSMO A positioning motor to build a complete drive system.

**The following general requirements must be observed:**

- The PROFIBUS DP coupling is realized in conformance with the norm. A standard PROFIBUS cable can be used. In order to loop-in the optional electronics power supply, the same bus cable can be used as is used in the distributed ET 200X I/O device.

**Note**
When using connector couplings for PROFIBUS, at higher data transfer rates (> 1.5 Mbaud), perfect functioning is no longer guaranteed (cable reflection).

- An external +24 V load power supply must be provided (voltage range: 24 V ±20 %).
- The maximum cross-section for the 24 V load power supply is 4 $mm^2$. If the power supply used can supply more current than is permissible for the particular cable, then appropriate fuses must be provided.
- A Power Management Module (PMM) can be optionally connected between the external load power supply and input terminals of SIMODRIVE POSMO A. The PMM is used to dissipate the regenerative feedback energy.
- If bus communications and position sensing are to remain active even with the load power supply powered-down, an optional electronics power supply can be connected (24 V ±20 %). The cable is routed in the ET 200X bus cable (distributed I/O system).
- A BERO can only be connected as a three-conductor PNP type.
- All of the power supplies must have “protective separation”.
- When using SIMODRIVE POSMO A in UL-approved plants and systems, a UL approved varistor must be used in the 24 V supply cable; it must have the characteristic data $V_n$ = 31 V DC / I MAX = 2000 A (e.g. SIOV-S20K25 from EPCOS, http://www.usa.epcos.com). When using the Power Management Module (PMM) the varistor is not necessary since it is part of the PMM.

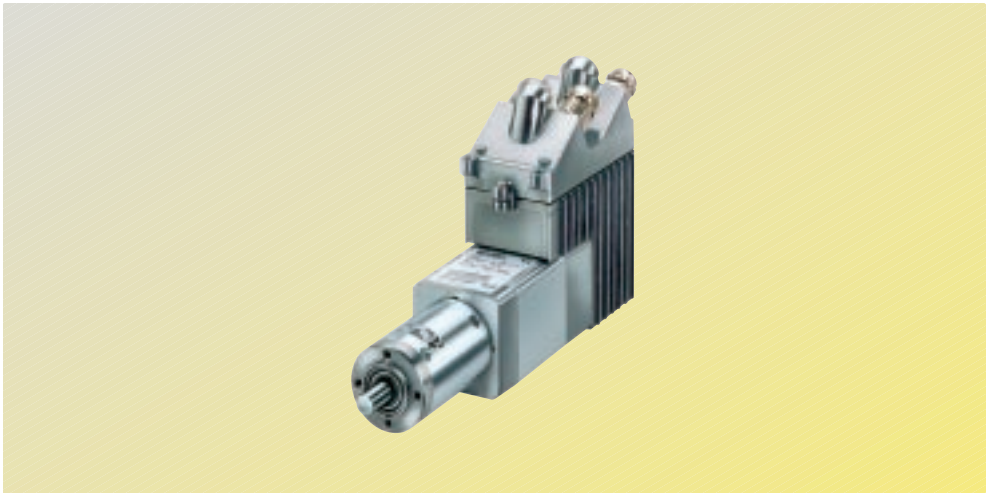


Fig. 6/89
SIMODRIVE POSMO A

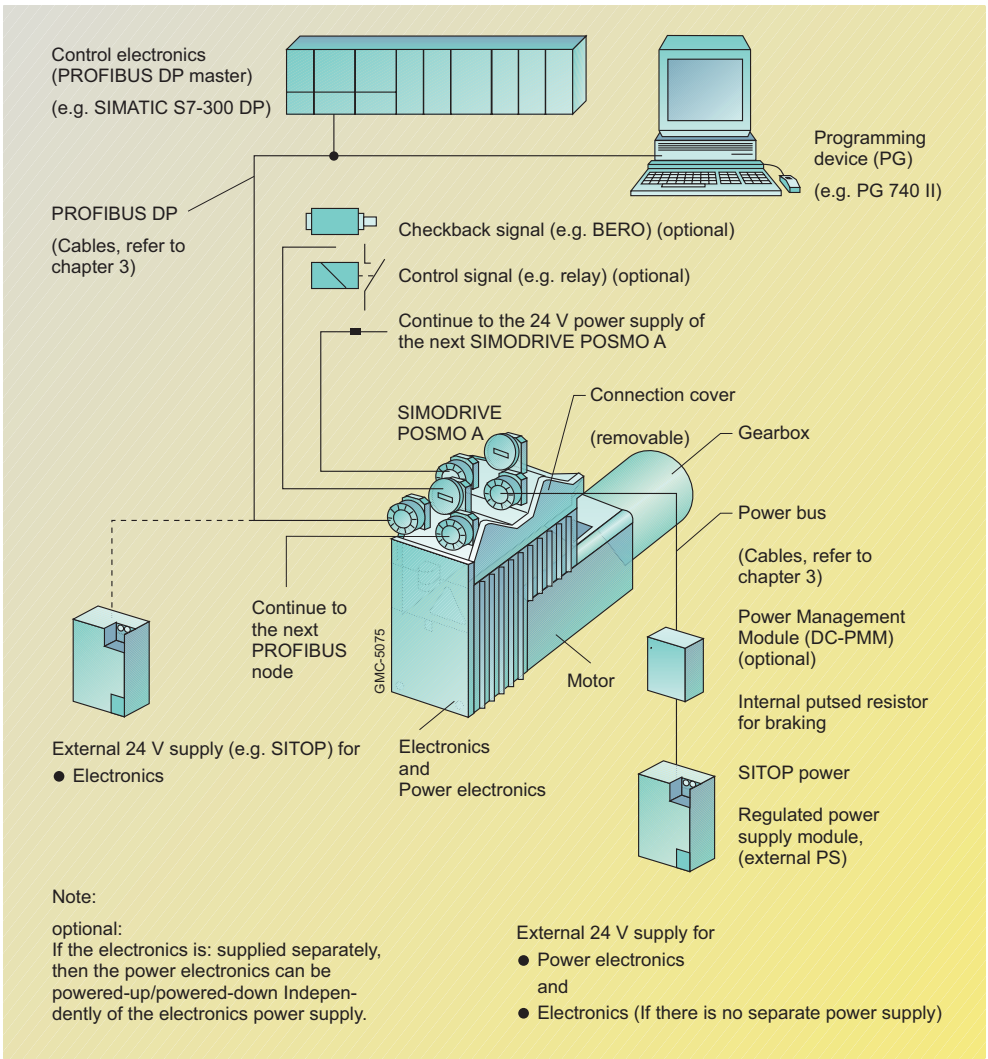
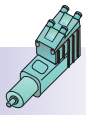

Control electronics
(PROFIBUS DP master)
(e.g. SIMATIC S7-300 DP)
Programming device (PG)
(e.g. PG 740 II)
PROFIBUS DP
(Cables, refer to chapter 3)
Checkback signal (e.g. BERO) (optional)
Control signal (e.g. relay) (optional)
Continue to the 24 V power supply of the next SIMODRIVE POSMO A
SIMODRIVE POSMO A
Connection cover
(removable)
Gearbox
Power bus
(Cables, refer to chapter 3)
Power Management Module (DC-PMM) (optional)
Internal putsed resistor for braking
SITOP power
Regulated power supply module, (external PS)
Continue to the next PROFIBUS node
GMC-5075
Motor
External 24 V supply (e.g. SITOP) for
● Electronics
Electronics and Power electronics
Note:
optional:
If the electronics is: supplied separately, then the power electronics can be powered-up/powered-down Independently of the electronics power supply.
External 24 V supply for
● Power electronics
and
● Electronics (If there is no separate power supply)

Fig. 6/90
System overview

- When using a contactor in the 24 V load power supply, before the bus contactor is opened, it must be ensured that the pulses have been canceled via PROFIBUS (OFF 1).



## Power supply sizing

The load power supply must be engineered as a function of the number of SIMODRIVE POSMO A positioning motors and the coincidence factor. A 24 V DC power supply can be used, which is generally used in many applications. For the technical data of the power as well as electronic supply voltage refer to chapter 2 (“Technical data”).

We recommend that a regulated SITOP power supply module is used for the 24 V load power supply.
5 A, 10 A, 20 A, 30 A and 40 A modules are available (see chapter 3).

If several SIMODRIVE POSMO A are used but they are not all simultaneously operational, then a lower rating load power supply can be used. However, a brief overload capability of the power supply must be guaranteed, as otherwise the electronics of the SIMODRIVE POSMO A would interpret voltage dips as an undervoltage condition, and trip.

Example 1:
Coincidence factor = 1
3 SIMODRIVE POSMO A (rated output, full speed 3 x 4.5 A = 13.5 A)
Select a SITOP power supply, 20 A

Example 2:
Coincidence factor = 0.75 (not all of the units are simultaneously operational)
3 SIMODRIVE POSMO A (rated output, full speed 3 x 0.75 x 4.5 A = 10.13 A)
Select a SITOP power supply, 10 A

In order to check whether the overload capability of the power supply is sufficient the maximum motor current can be calculated by the following equation.

$$I_{\text{max mot}} = \frac{\tau_{\text{max at gearshaft}}}{K_t \cdot i_{\text{POSMO gear}} \cdot \eta_{\text{POSMO gear}}}$$

$\tau_{\text{max at gearshaft}}$ = Maximum torque at gearshaft [Nm]
$i_{\text{POSMO gear}}$ = POSMO A gearbox ratio
$K_t$ = Torque constant (0.04 Nm/A; 0.354 lb-in/A)
$\eta_{\text{gear POSMO}}$ = POSMO A gearbox efficiency

## Regenerative feedback protection

If SIMODRIVE POSMO A is used in a plant or system with low mechanical friction, the electrical power regenerated when braking can increase the level of the 24 V load power supply. If the drive is braked from the maximum speed, then a typical braking energy of 1.5 Ws per drive must be calculated.

If a pulsed power supply is used (e.g. SITOP power), generally, feedback protection must be provided.

When using an uncontrolled 24 V power supply (transformer, rectifier), typically operation with between 3 and 5 SIMODRIVE POSMO A drives is possible without any supplementary circuitry.

The simplest regenerative feedback protection design is shown in Fig. 6/91. The circuit is typically suitable for operation with up to 3 axes.

The electrolytic capacitor (Elko) must have at least a capacitance of 15,000 µF to safely store the average braking energy (≈ 1.5 Ws) of one POSMO A unit.

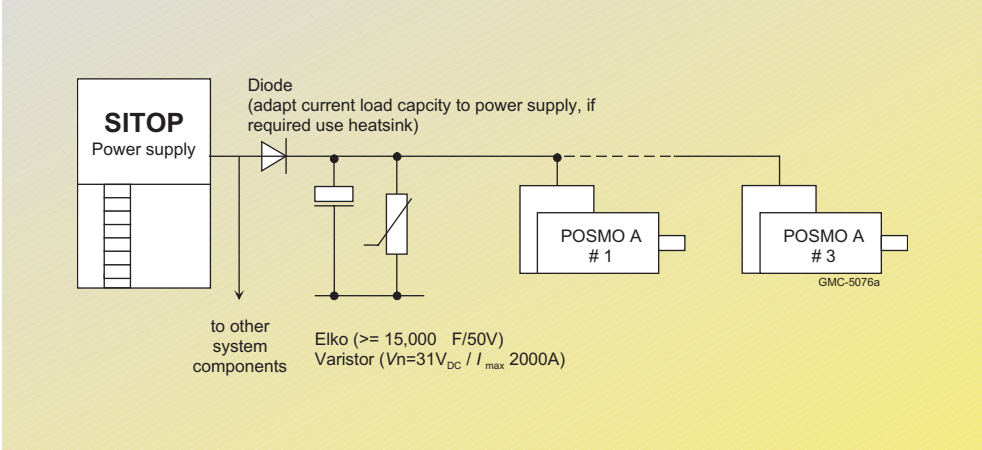



Fig. 6/91
Regenerative feedback protection design

You can check whether the capacitor is correctly sized for your application when having the torque or power profile of your application available. From the torque profile determine the braking power by considering only the negative torque values.

$$P_{br}\,[\text{W}] = \frac{\tau[\text{Nm}] \cdot |n|[\text{rpm}]}{9.55}$$

Calculate the braking energy $W_{br}$ from the braking power $P_{br}$ and the braking time $t_{br}$.

$$W_{br}\,[\text{Ws}] = \frac{1}{2} \cdot \frac{P_{br}}{i_{\text{POSMO gear}}} \cdot \eta_{\text{POSMO mot}} \cdot \eta_{\text{gear POSMO}} \cdot t_{br}$$

$P_{br}$ = Braking Power [W]
$i_{\text{POSMO gear}}$ = POSMO A gearbox ratio
$\eta_{\text{POSMO mot}}$ = POSMO A motor efficiency (65%)
$\eta_{\text{gear POSMO}}$ = POSMO A gearbox efficiency
$t_{br}$ = Time while braking is power applied [s]

## Regenerative feedback protection

To determine the energy storage capacity of the capacitor use the following equation.

$$W_{\text{storage C}}[\text{Ws}] = \frac{1}{2} \cdot C \cdot \left(V_{\text{reg}}^2 - V_{\text{supply}}^2\right) \cdot 10^{-6}$$

$C$ = Capacitance [µF]
$V_{\text{reg}}$ = Voltage generated by POSMO A during braking (≈ 29 to 30 V)
$V_{\text{supply}}$ = Supply voltage of power supply (24 V)

The capacitor is sized large enough for one POSMO A when $W_{\text{storage C}} \geq W_{\text{br max}}$. If two or more POSMO A's are feeding back energy simultaneously into the same capacitor then the capacitor may be sized by using a coincidence factor $CF_{\text{br}}$ for braking (similar to the one used for sizing the power supply). For the worst case scenario, all the POSMO A's brake at the same time with the maximum braking energy, the $CF_{\text{br}}$ factor equals one.

$$W_{\text{storage C}} \geq CF_{\text{br}} \cdot \sum W_{\text{br max}}$$

## Power Management Module (DC-PMM/24 V)

If several axes are simultaneously braked in a system due to the operating situation, e.g. for EMERGENCY OFF, or if the axes are essentially traversed simultaneously, a Power Management Module can be used to dissipate the regenerative feedback power.
The PMM is connected between the load power supply and the first SIMODRIVE POSMO A positioning motor.

Functions and features (as example):

- The regenerative feedback energy is dissipated using an integrated pulsed resistor with $I^2t$ monitoring
- Regenerative feedback protection
- Messages
  – Ready
  – Fault
  – Regenerative feedback
- If the machine safety demands it:

  Control circuit to control a relay for "start inhibit".

The maximum permissible number of positioning motors which can be connected to a DC-PMM/24 V module depends on the coincidence factor for the regenerative feedback and is calculated using the following formula:

$$N_{\text{POSMO A on PMM}} = \frac{6.7}{\text{Number of braking operations per second}}$$

Example:
One DC-PMM/24 V is adequate when braking 6 SIMODRIVE POSMO A per second from the maximum speed simultaneously.

Fig. 6/92
Power Management Module

6

## Connecting and wiring overview



The SIMODRIVE POSMO A wiring is completely realized in the connection cover. This design makes it especially quick and easy to replace a unit. The cover will be released from the old motor (with 2 screws) and put onto the new motor without having to remove the wiring.

All cables enter through PG glands.

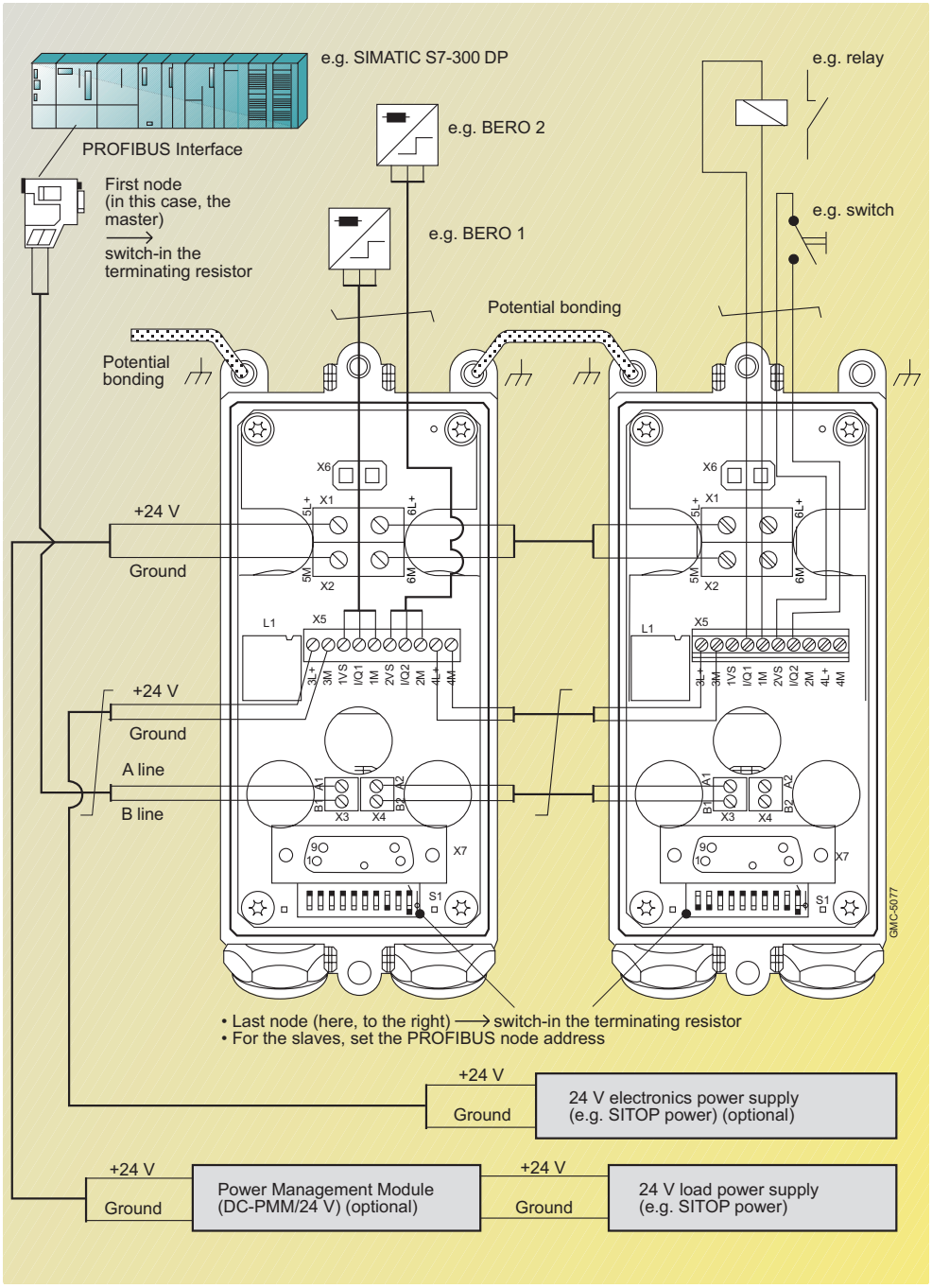
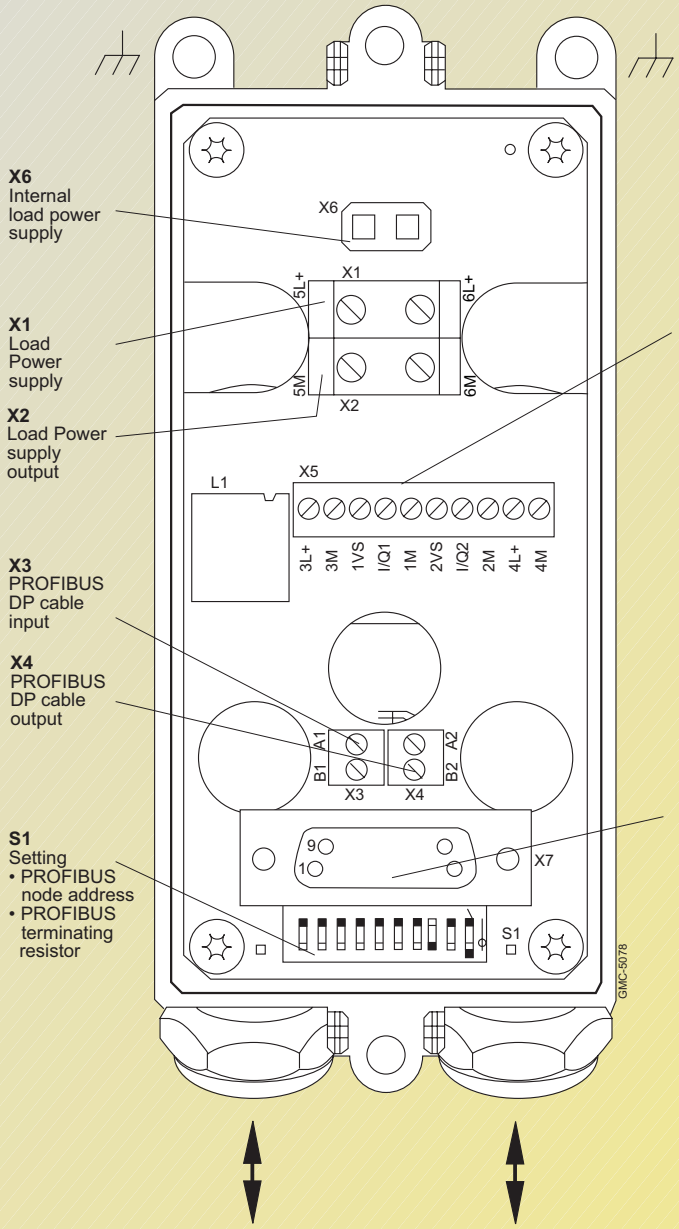



Fig. 6/93
Connecting and wiring overview




**X6**
Internal load power supply

**X1**
Load Power supply

**X2**
Load Power supply output

**X3**
PROFIBUS DP cable input

**X4**
PROFIBUS DP cable output

**S1**
Setting
- PROFIBUS node address
- PROFIBUS terminating resistor

**X5**

| | |
|---|---|
| 3L+ | + 24V electronics power supply input (optional) |
| 3M | 0 V ground |
| 1VS | supply 1 |
| I/Q1 | digital input / output |
| 1M | 0 V ground |
| 2VS | supply 2 |
| I/Q2 | digital input / output |
| 2M | 0 V ground |
| 4L+ | + 24V electronics power supply output (optional) |
| 4M | 0 V ground |

**X7**
Internal Interface

**Note:**
Screwdriver for terminals (slotted screws)

| Where? | Size! |
|---|---|
| • X1 and X2 | 1 (0.5 x 3.5) |
| • X3, X4 and X5 | 0 (0.4 x 2.5) |

Fig. 6/94
Terminals

## Overview PROFIBUS-DP

SIMODRIVE POSMO A is exclusively controlled and parameterized via PROFIBUS.

This means that communications must be established between the “DP master” and the “DP slave POSMO A” to be commissioned.

PROFIBUS-DP is an international open fieldbus standard optimized for fast data transfer (up to 12 Mbaud) at the field level, where timing is critical. The fieldbus is used for cyclic and non-cyclic data transfer between a master and the slaves which are assigned to it. The SIMODRIVE POSMO A is a slave on the fieldbus.

What are the communication possibilities?

- Start-up tool “POSMO A Master”.
- DP Master SIMATIC S5 or S7
- Third party master

Stand alone operation, without PROFIBUS communication is possible. However, to parameterize the drive accordingly you need to have initial access via one of the three above mentioned communication possibilities.

PROFIBUS devices have different performance features. In order that all master systems can correctly address the DP slave, the characteristic features of the slave are summarized in a master device file (GSD). This file needs to be installed in the directory “\GSD”. The GSD file for the SIMODRIVE POSMO A “SIEM8054.GSD” can be obtained from your local Siemens office (sales partner) or via the Internet: http://www.profibus.com/gsd/

Data transfer between the master and the slave uses the master-slave technique, whereby the drives are always the slaves. This allows extremely fast cyclic data transfer. POSMO A uses the PPO type 1 (Parameter Process Data Object) data structure as defined by the PROFIBUS organization.

PPO type 1 (PPO1) is structured as follows:

- 4 words for the parameter area (PKW, parameter ID value).

This telegram part is used to read and/or write parameters and to read out faults.

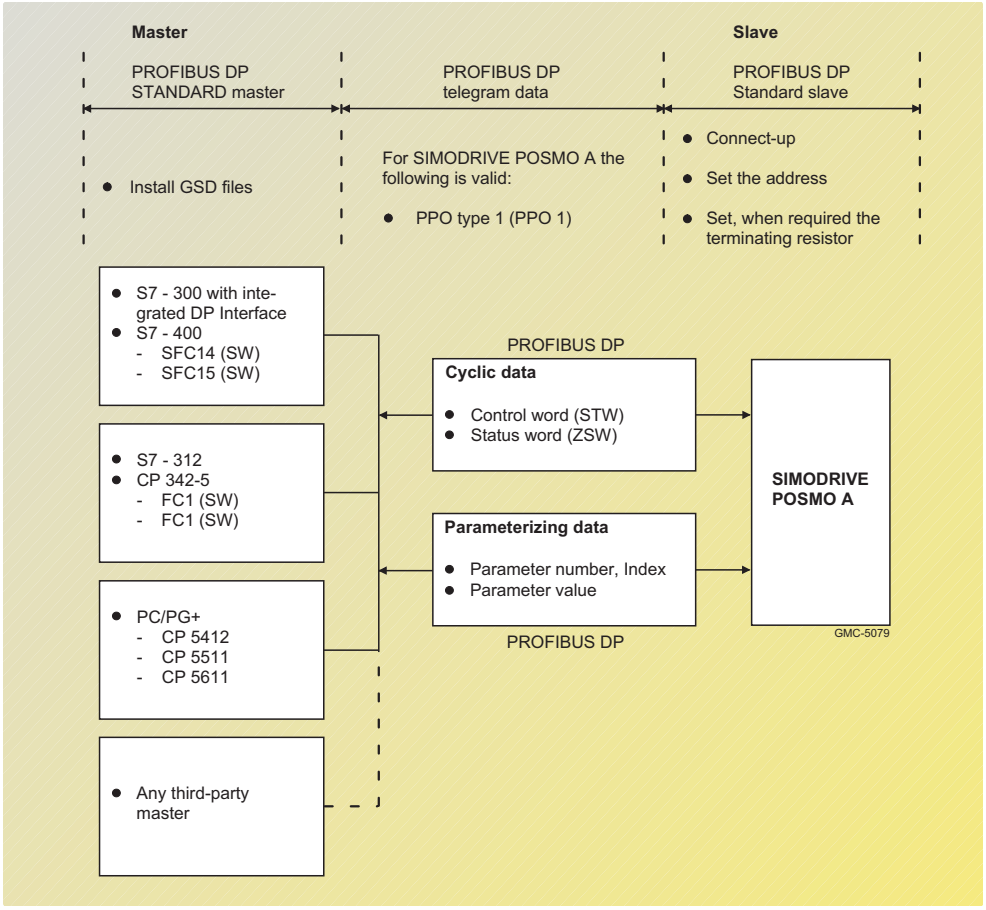



Fig. 6/95

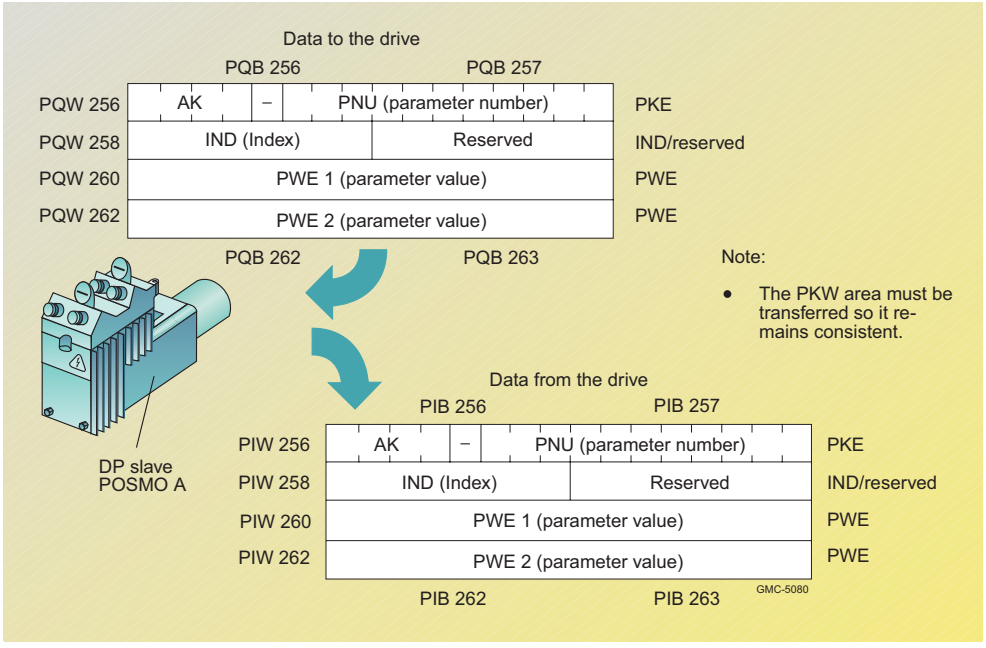



Fig. 6/96
Data transferred in the PKW area (addresses for example only)

- 2 words for the process data area (PZD area).
  This area contains the control words, setpoints and status information and actual values.

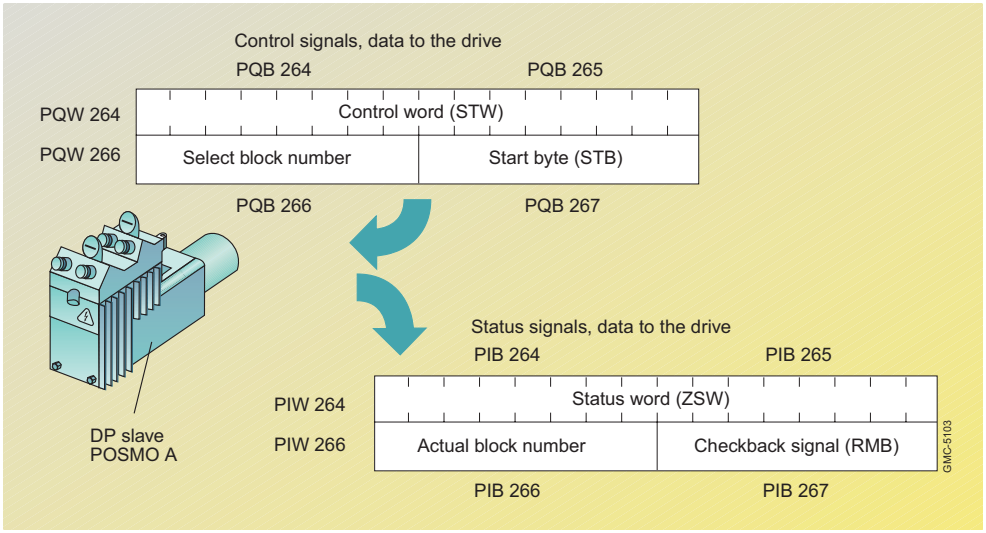



Fig. 6/97
Data transferred in the PZD area (addresses are for example only)

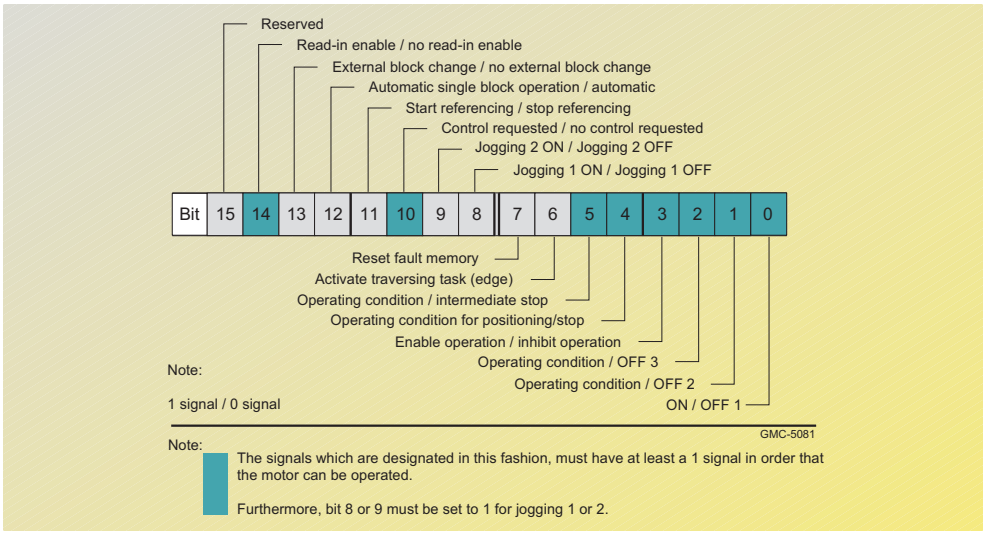

Reserved
Read-in enable / no read-in enable
External block change / no external block change
Automatic single block operation / automatic
Start referencing / stop referencing
Control requested / no control requested
Jogging 2 ON / Jogging 2 OFF
Jogging 1 ON / Jogging 1 OFF
Bit 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
Reset fault memory
Activate traversing task (edge)
Operating condition / intermediate stop
Operating condition for positioning/stop
Enable operation / inhibit operation
Operating condition / OFF 3
Operating condition / OFF 2
ON / OFF 1
Note:
1 signal / 0 signal
GMC-5081
Note:
The signals which are designated in this fashion, must have at least a 1 signal in order that the motor can be operated.
Furthermore, bit 8 or 9 must be set to 1 for jogging 1 or 2.

Fig. 6/98
Structure Control Word (STW)

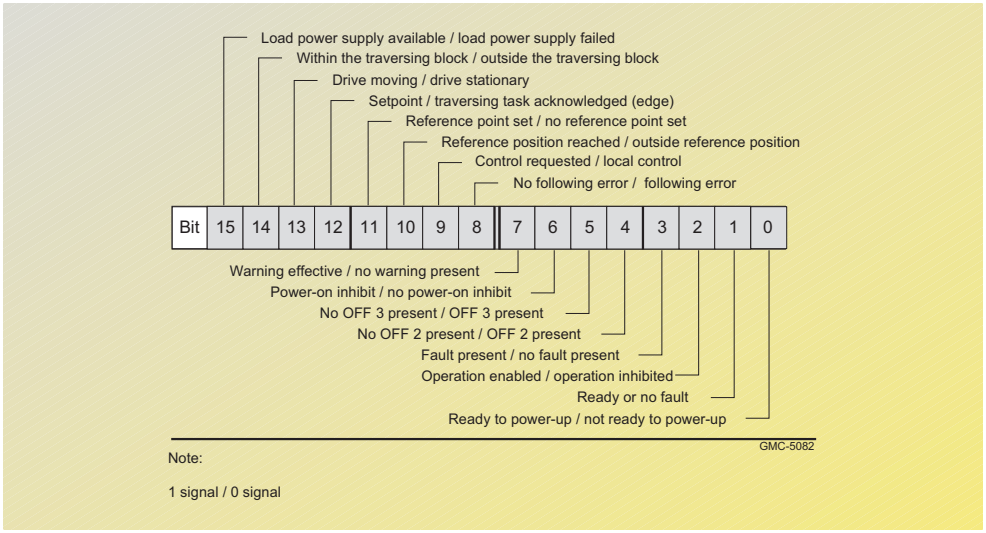
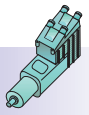

Load power supply available / load power supply failed
Within the traversing block / outside the traversing block
Drive moving / drive stationary
Setpoint / traversing task acknowledged (edge)
Reference point set / no reference point set
Reference position reached / outside reference position
Control requested / local control
No following error / following error
Bit 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
Warning effective / no warning present
Power-on inhibit / no power-on inhibit
No OFF 3 present / OFF 3 present
No OFF 2 present / OFF 2 present
Fault present / no fault present
Operation enabled / operation inhibited
Ready or no fault
Ready to power-up / not ready to power-up
GMC-5082
Note:
1 signal / 0 signal

Fig. 6/99
Structure Status Word (ZSW)



## SIMATIC S7 function blocks

In order to make it simpler to control and parameterize a SIMODRIVE POSMO A positioning motor from the SIMATIC S7 program certain function blocks have been developed. This means that a drive, for instance, can be parameterized without being knowledgeable about PROFIBUS parameter formats and the task IDs.

You can receive the function blocks at no charge from the documentation CD
# RMS 02055

## FB 10 “CONTROL POSMO A”

You can control the SIMODRIVE POSMO A, connected under the specified peripheral address via FB 10.

The following functions are available:

- Initialization
  Sets the drive into “ready to traverse status”
- Referencing
  Sets the reference point for the drive.
- Jogging
  The drive traverses closed-loop speed controlled in the positive or negative direction.
- Program processing
  Starts, stops or exits the individual block addressed with “block_number” or a block within a program.
- MDI
  Traverses the drive to a transferred position with the transferred velocity and acceleration.
  The MDI parameters are transferred in block 3. The MDI block can be started using “Block_number” = 3 and “Start” = “1”.
- Fault acknowledgment
  Acknowledges a drive fault.

The following checkback signals are available:

- Actual traversing block
- Ready-to-run
- Warning and fault information
- Complete status (status word and checkback signal byte)

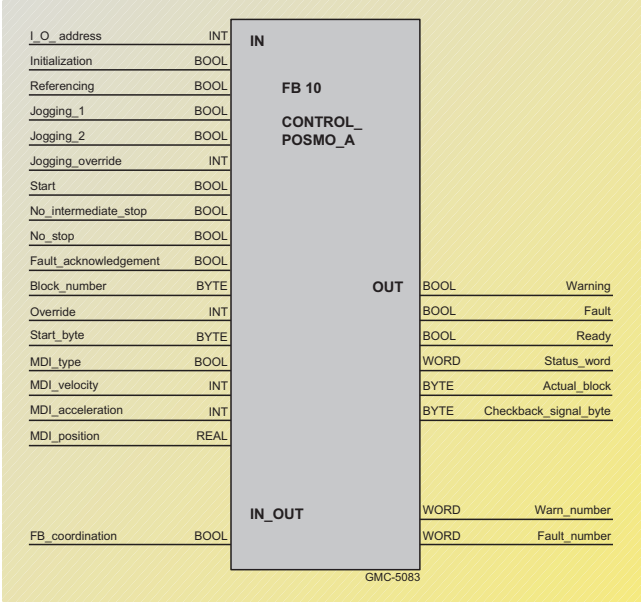



Fig. 6/100
FB 10 Control POSMO A

## FB 11 “PARAMETERIZE POSMO A”

Using FB 11 SIMODRIVE POSMO A can be parameterized, connected under the specified address.

The following functions are available:

- Read parameter
  Provides the value of the specified parameter.
- Write parameter value
  Sets the specified parameter to the specified value.
- Load the factory setting
  Resets the parameter configuration to the factory default setting.
- Save parameter
  Saves the actual parameter configuration in the non-volatile memory (FLASH EPROM).

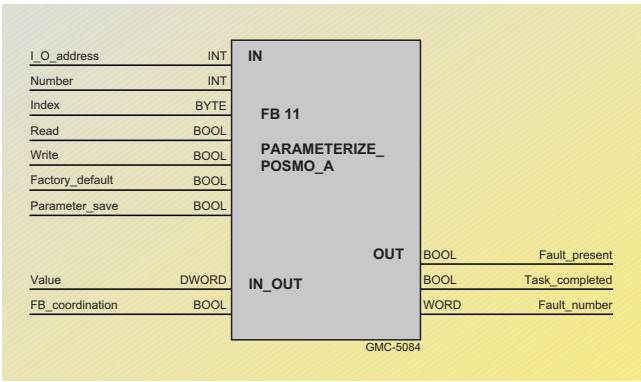



Fig. 6/101
FB 11 PARAMETERIZE POSMO A

## FB 12 “PARAMETERIZE ALL POSMO A” (upread & download)

The FB 12 can be used to read and write the parameter set of the SIMODRIVE POSMO A connected under the stated I_O_address.

The data for reading and writing are stored in the instance data block of each FB 12 call.

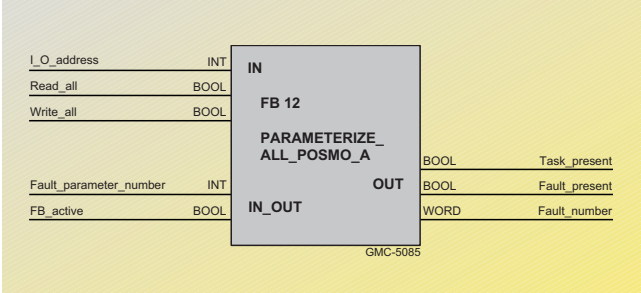



Fig. 6/102
FB 12 PARAMETERIZE ALL POSMO A

## Start-up tool "POSMO A Master"

The SIMODRIVE POSMO A PROFIBUS MASTER tool allows data to be transferred between a PG, PC or notebook and a SIMODRIVE POSMO A via the PROFIBUS-DP fieldbus.
The connection to PROFIBUS is realized using the SIMATIC NET DP programming interface.

The tool is Windows based (95/98/NT) and available free of charge as part of the General Motion Control CD-ROM or can be requested from your local Siemens Sales representative (sales partner).

The most important functions of the start-up tool include:

- Controlling SIMODRIVE POSMO A via control signals
- Displaying status signals (e.g. status word, actual values)
- Programming, selecting and starting traversing blocks
- Reading and writing individual parameters
- Saving and loading all parameters (including traversing blocks)
- Establishing the factory presetting, etc.

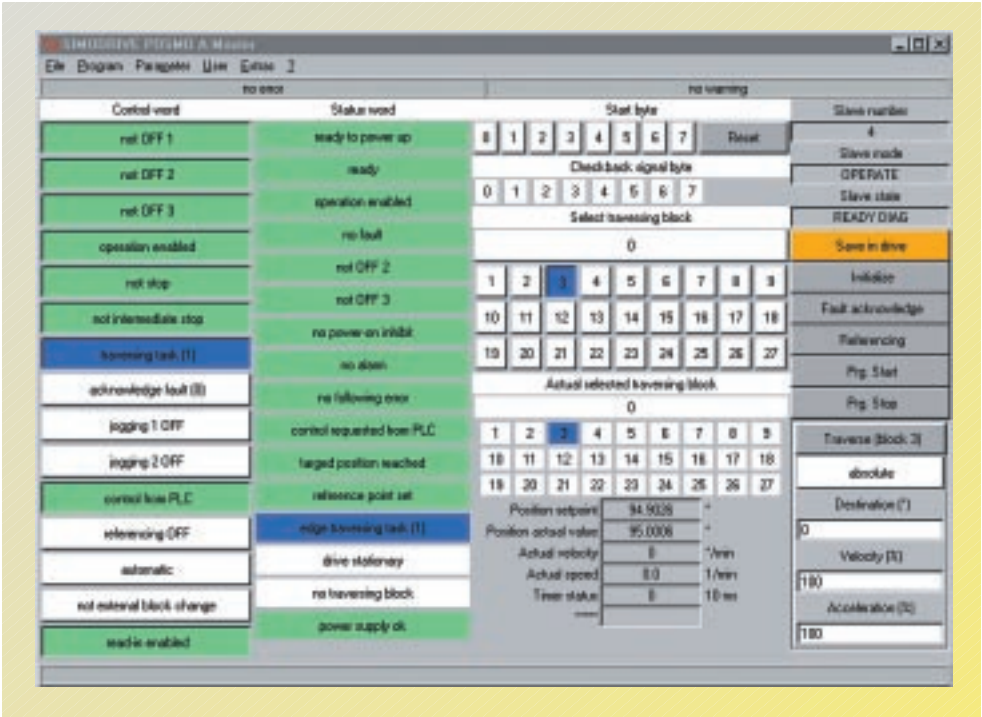



Fig. 6/103

The following hardware and software environment is required in order to use the tool:

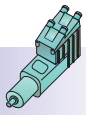
- The PG, PC or Notebook must have
  - Operating system: Windows 95® / 98® / NT®
  - 32 MB RAM memory
  - 10 MB memory on the hard disk
- Requirements placed on the communications

  For Laptops:
  - CP 5511 (PROFIBUS connection via PCMCIA card)

  Design:
  Type 2 PCMCIA card + adapter with 9-pin SUB-D socket connector to connect to PROFIBUS.
  Order No. (MLFB):
  6GK1551-1AA00

  For Desktops:
  - CP 5611 (PROFIBUS connection via short PCI card, for Desktops)

  Design:
  Short PCI card with 9-pin SUB-D socket connector to connect to PROFIBUS.
  Order No. (MLFB):
  6GK1561-1AA00
- Software requirements
  - SIMATIC NET, SOFTNET-DP/Windows 98 NT 4.0/5.0 or newer
    Order No. (MLFB):
    6GK1704-5DW _ _ -3AA0
  - TCL/TK Interpreter, Version 8.0 (is included in the installation software)



## Traversing blocks and programs

For SIMODRIVE POSMO A, there are a total of 27 traversing blocks available. The components of each traversing block consists of:

- Program control word (PSW) allows to specify motion type (speed or position controlled), positioning type (absolute or relative), timer type (for timer operations in program blocks), traversing type (path or precise stop controlled), etc.
- Target position (mm, degrees or inch)
- Velocity value (0 to 100%)
- Acceleration value (0 to 100%)
- Timer value (0.01 to 10,000 s)
- Signaling position
  When passing a specified position, the bits specified in the position mask are set and signaled to the master via the checkback signal byte.
- Start signals
  The traversing block starts as soon as, in addition to the standard enable signals (OFF1, OFF2, etc.), all of the configured bits of the start byte have been set. If one of the bits is withdrawn traversing stops and the block is ended.
  Specified bits can also be activated when a traversing block starts. Bits are reset at the end of the block.
- Stop and positioning signals
  Specified bits can be activated at the end of a traversing block, they are automatically reset at the start of a new traversing block.
  Specified bits can be activated when passing the specified signaling position. The position feedback bits are reset when starting a new traversing block.

## Operating modes

### *Jogging mode*

Traversing blocks 1 and 2 are reserved for jogging. They are executed by setting the appropriate bit in the control word (see control word structure). After the signal has been withdrawn the block is stopped.

Traversing blocks 1 and 2 are reserved for jogging. Traversing blocks 3 to 27 can either be executed as single blocks or be combined to form program blocks. Single blocks must be individually selected and started. A program is started by selecting and starting a block within the program, the additional blocks are then automatically executed as programmed.

### *Manual Data Input (MDI)*

For SIMODRIVE POSMO A, MDI operation is replaced by selecting a single traversing block. New coordinates are programmed by overwriting one of the traversing blocks and then transferred at the next start.

### *Automatic*

In the “automatic mode”, traversing blocks and programs can be selected, started and their behavior significantly influenced via the interface.
By starting the first traversing block of a program all the subsequent following traversing blocks within this program will be automatically executed.

## Referencing

For SIMODRIVE POSMO A, there is an incremental position measuring system. The measuring system must be synchronized with the axis in order that positioning motor recognizes the axis zero.

There are several referencing possibilities:

### *1. Axis without reference cam*

- Referencing by approaching visual mark or end stop. After approaching designated reference position the required actual value of this position can be parameterized, for instance position will become zero position by setting parameter P40 to zero. Or by setting control bit 11 the position of the last zero mark from the encoder (4 zero marks per revolution) is automatically overwritten by a specified parameter value (reference point coordinate). An actual position value can also be set in a traversing block through the program control word of the traversing block.

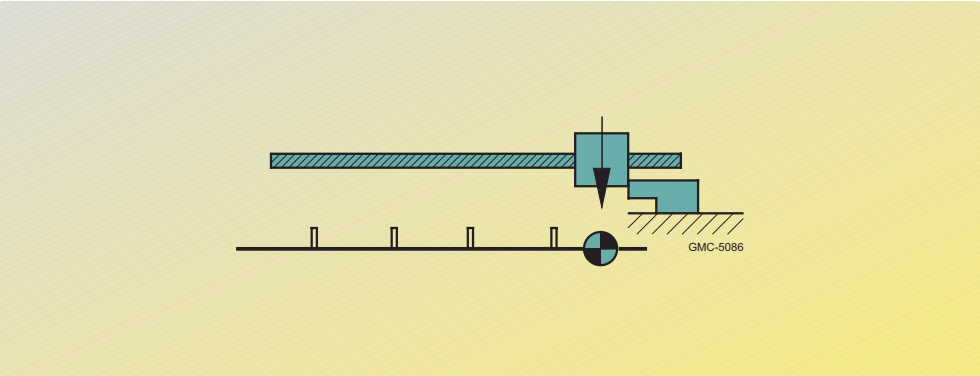



Fig. 6/104

### *2. Axis with reference cam*

- Reference travel to BERO (proximity switch) with and without directional reversal.

The reference point approach is executed via a program (2 combined traversing blocks). The position of the last zero mark before the end of the last traversing block is set to the specified reference point coordinate.

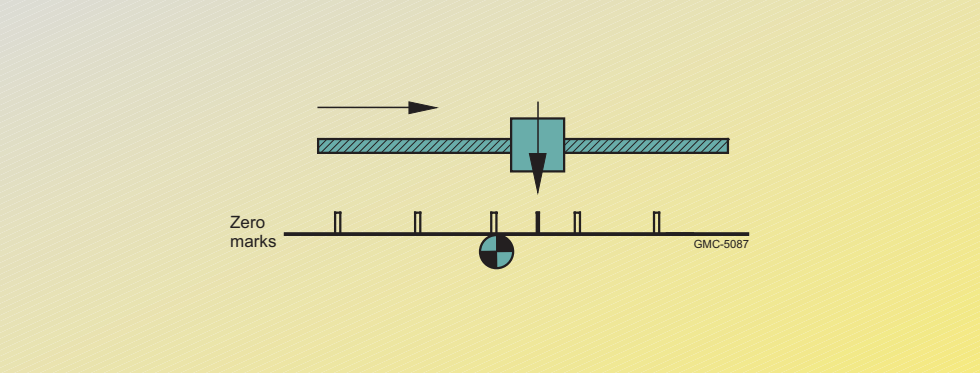



Fig. 6/105

## Axis setup

SIMODRIVE POSMO A can be set up for linear and rotary axis. The dimension units for the parameter values can be switched between millimeters [mm] and inches [in] for linear axis and is expressed in degrees for rotary axis.

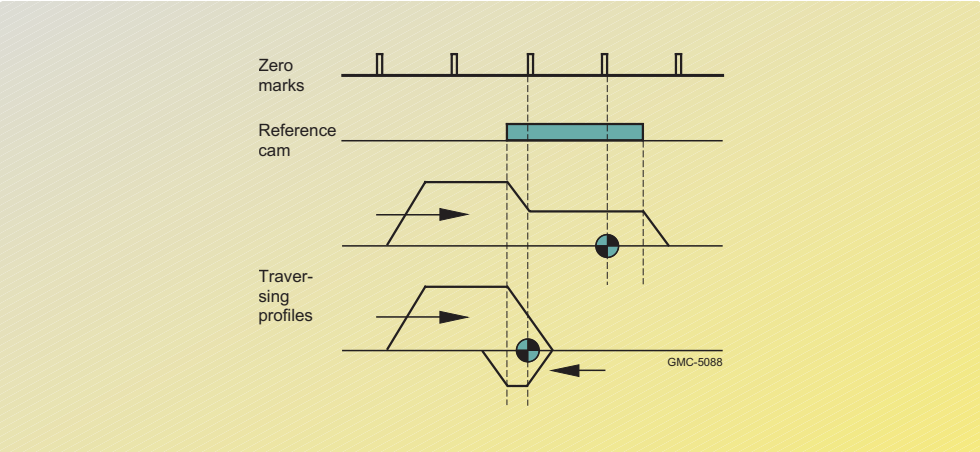
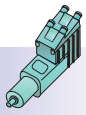



Fig. 6/106

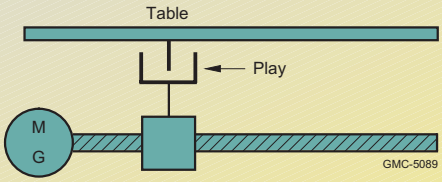


## Backlash compensation

When an indirect measuring system is used (position measuring encoder at the motor), at each direction reversal, the mechanical play is first traveled through, before the axis moves.

For axes with indirect position sensing, mechanical play causes the traversing distance to be falsified, as, at direction of reversal, the axis traverses too little by the amount of play.

After the backlash compensation has been entered, at each direction reversal the actual value of the axis can be corrected as a function of the actual traversing direction.




The encoder actual value leads, at direction reversal, by the actual value (table).

⟶ the table does not travel far enough
⟶ positive backlash (normal case)

Fig. 6/107

## Jerk limiting

Acceleration and deceleration change as a step-like function if there is no jerk limiting.

With jerk limiting, a ramp-type increase (jerk) can be parameterized together for both quantities, so that accelerating and braking are soft (jerk limited).

Jerk limiting can be used, for example, for positioning tasks with fluids and liquids or to generally reduce the stressing on the mechanical system of an axis.

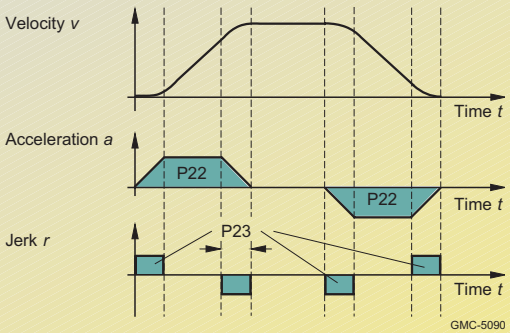



Fig. 6/108
System overview

## Inputs / Outputs

For SIMODRIVE POSMO A there are two fast and freely parameterizable input / output terminals. The function of a terminal is defined by appropriate parameterization.

## Stand-alone operation (without bus communication)

Safety signals, e.g. OFF1 are continually required. This means that when bus communications are interrupted, the motor is immediately shut down with fault. This can be prevented using the control word simulation in Parameter P100.

If the value of P100 is not equal to zero (e.g. 443F hex), when the communications fail, after 3 seconds, the control word is replaced by this value. The terminal signals remain active with the highest priority.

For stand-alone operation, for SIMODRIVE POSMO A, a maximum of 10 traversing blocks can be entered. These specified blocks are executed one after the other in stand-alone operation.

By using the two digital inputs up to three traversing blocks can be activated and executed.

## Fault displays and messages

On the back side of the SIMODRIVE POSMO A is a three color LED. According to the lit (flashing, steady) and the color sequence the status of the unit can be determined.

Since it is not possible for the SIMODRIVE POSMO A to display the fault and warning numbers, they must be read-out via PROFIBUS.
Bit 7 in the status word on high indicates that there is at least one warning present.

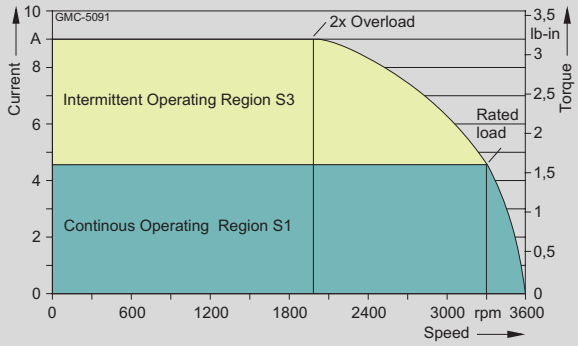



Fig. 6/109
POSMO A 75 W w/o gearbox
6SN21 32-0AA11-1BA0

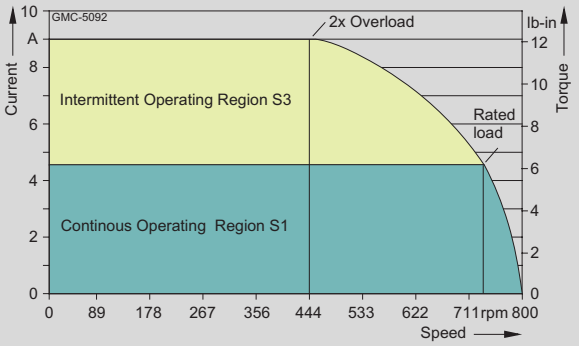



Fig. 6/110
POSMO A 75 W PG Gearbox ratio 4.5
6SN21 32-1BC11-1BA0

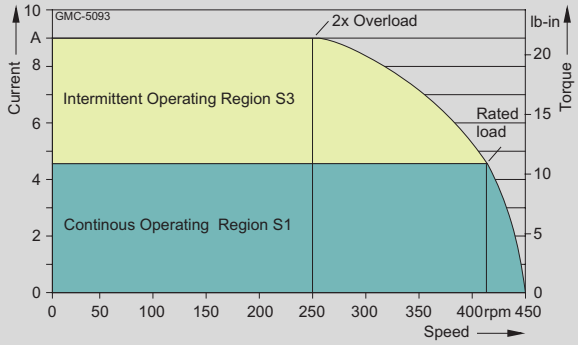



Fig. 6/111
POSMO A 75 W PG Gearbox ratio 8.0
6SN21 32-1BF11-1BA0

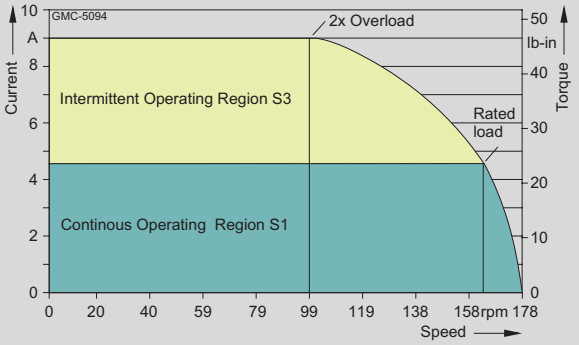



Fig. 6/112
POSMO A 75 W PG Gearbox ratio 20.25
6SN21 32-1CK11-1BA0

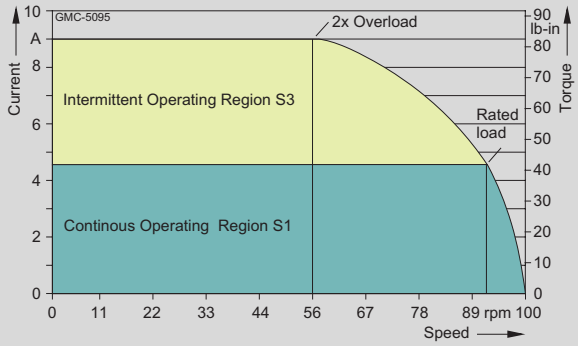



Fig. 6/113
POSMO A 75 W PG Gearbox ratio 36
6SN21 32-1CR11-1BA0

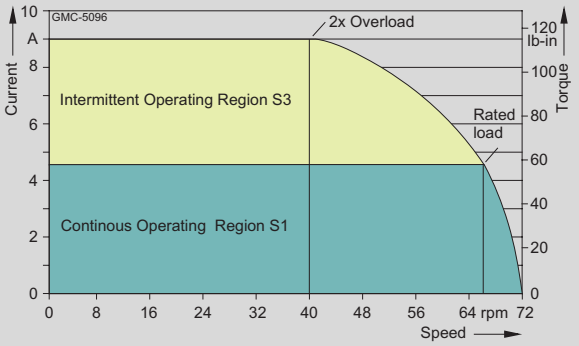



Fig. 6/114
POSMO A 75 W PG Gearbox ratio 50
6SN21 32-1CU11-1BA0

## Current/Torque – Speed curves for POSMO A 75 W



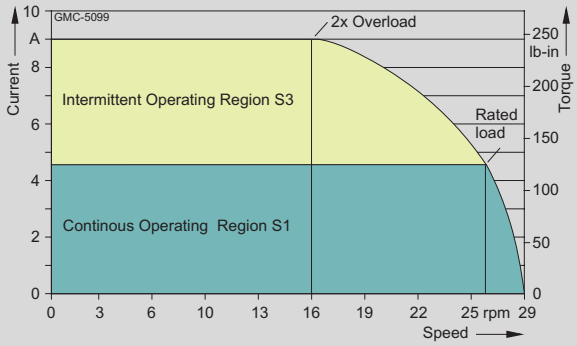



Fig. 6/115
POSMO A 75 W PG Gearbox ratio 126.26
6SN21 32-1DE11-1BA0

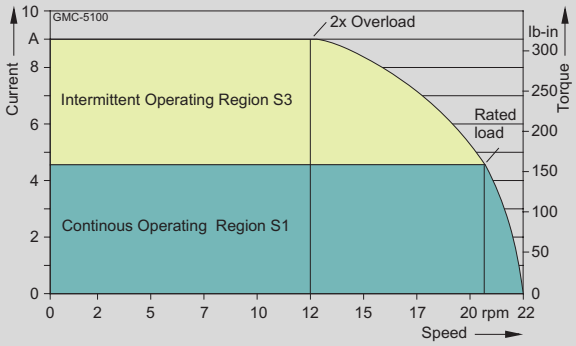



Fig. 6/116
POSMO A 75 W PG Gearbox ratio 162
6SN21 32-1DH11-1BA0

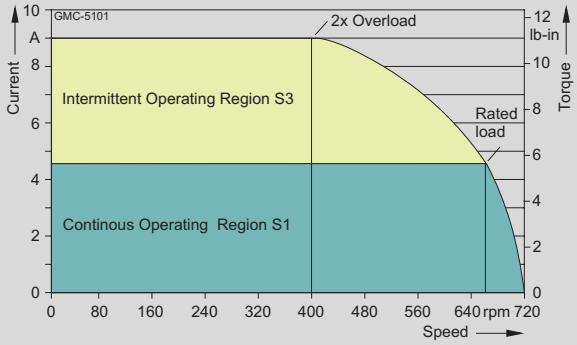



Fig. 6/117
POSMO A 75 W SG80 Worm gear 5
6SN21 32-1KD11-1BA0

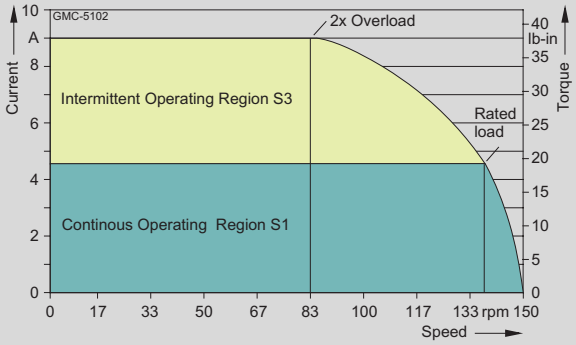
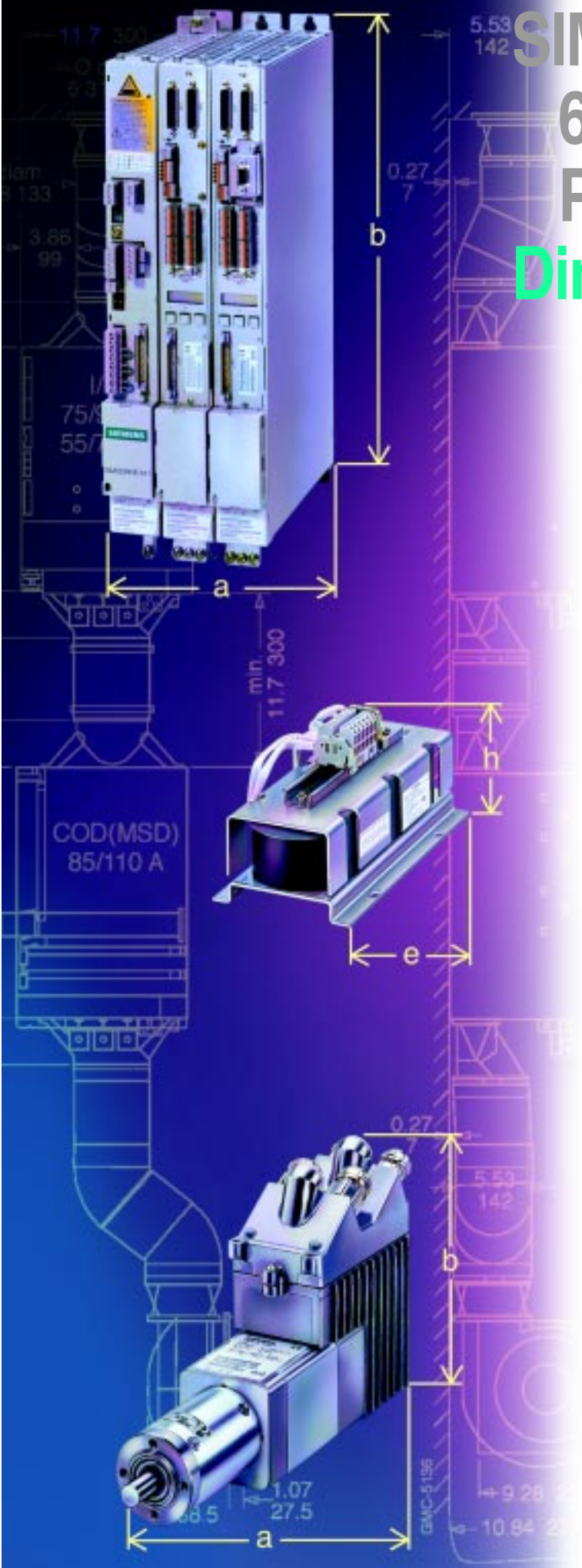



Fig. 6/118
POSMO A 75 W SG80 Worm gear 24
6SN21 32-1KM11-1BA0




# SIMODRIVE 611 universal POSMO A

# Dimension Drawings


*SIMODRIVE 611 universal*

**Overview drawings**

7/2 Infeed, power and monitoring modules
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*SIMODRIVE POSMO A*

**Detailed drawings**

7/16 POSMO A without gearbox
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7/16 Worm gearbox


**Note, important!**

Dimensions are subject to change.

7

## Infeed, power and monitoring modules

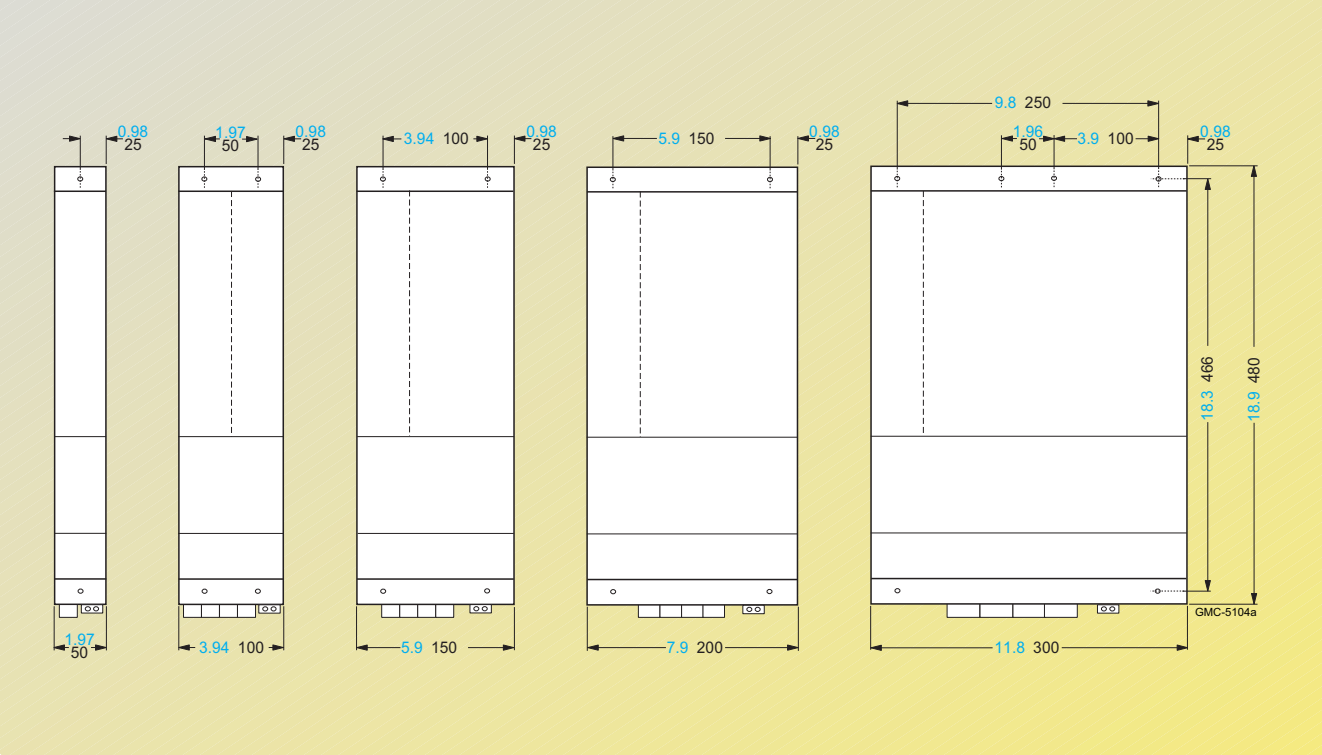



Fig. 7/1
**Front views**
(without shield terminal plate)

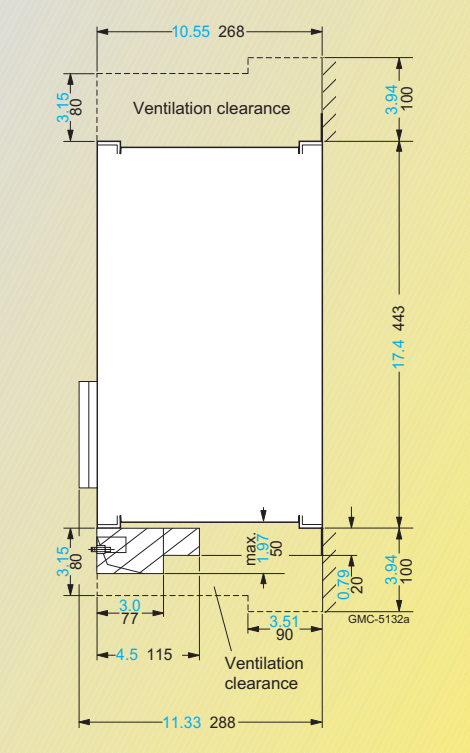



Fig. 7/2
**Side view** (without shield terminal plate)
Internal cooling

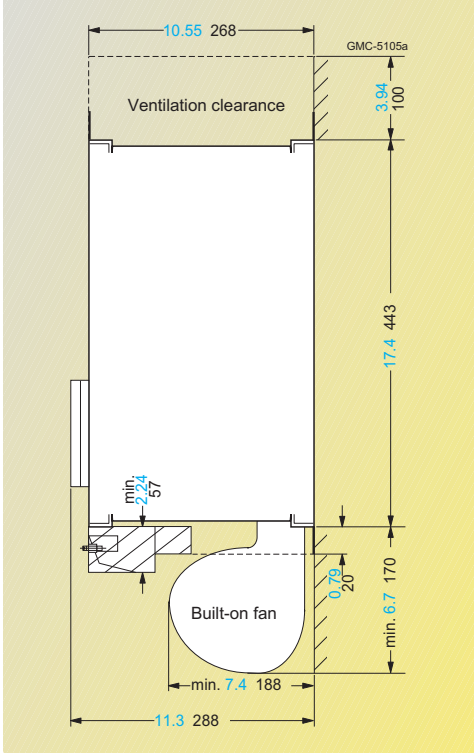



Fig. 7/3
**Side view** (without shield terminal plate)
Internal cooling with built-on fan

The shield terminal plates increase the module heights by the following amounts:

| Module width in (mm) | Increase of the module height downwards from the lower edge of the connection lugs in (mm) |
|---|---|
| 1.97 (50), 3.9 (100), 5.9 (150), 7.9 (200), 11.8 (300) | 3.9 (100), 7.02 (180) |

The thermally conducting cover (with internal cooling only) increases the module heights by the following amounts:

| Module width in (mm) | Increase of the module height upwards from the upper edge of the module casing in (mm) |
|---|---|
| 1.97 (50), 3.9 (100) | 3.9 (100) |

The Planning Guide contains further detailed dimensions.

Dimension in inches
Dimension in mm

## Infeed, power and monitoring modules

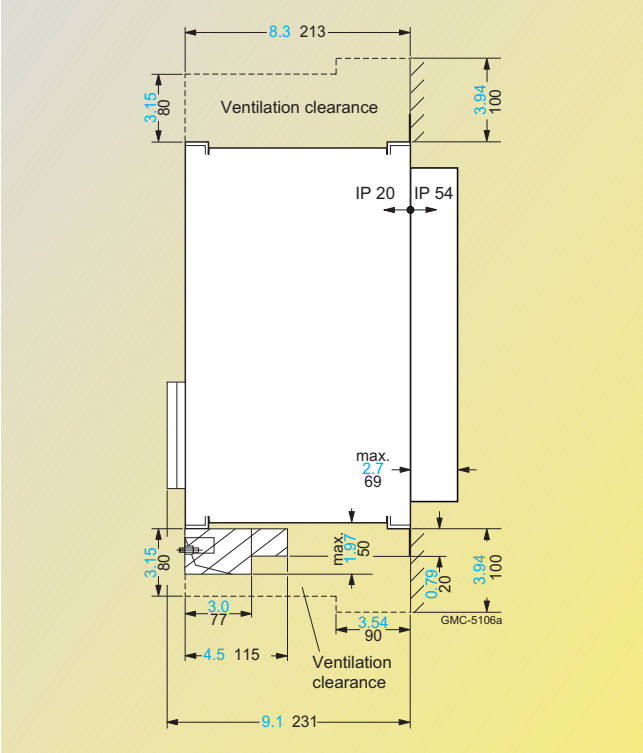



Fig. 7/4
**Side view** (without shield terminal plate)
External cooling
Module widths: 1.970 in (50 mm), 3.940 in (100 mm), 5.910 in (150 mm), 7.880 in (200 mm)

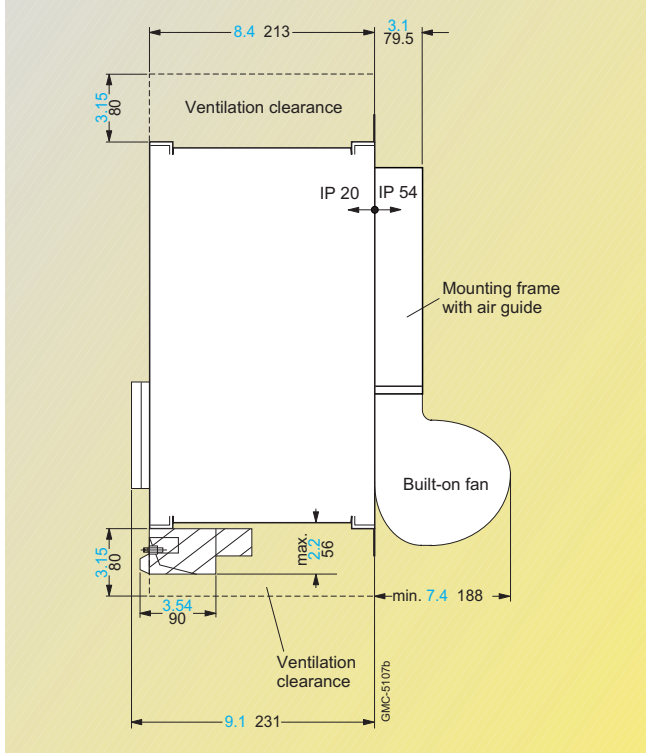



Fig. 7/5
**Side view** (without shield terminal plate)
External cooling
Module width: 11.820 in (300 mm)

## External pulsed resistors

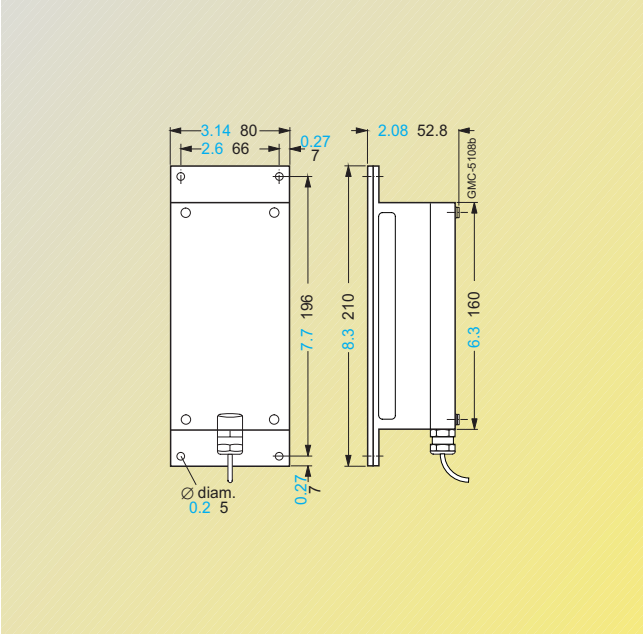



Fig. 7/6
Pulsed resistor 0.3 kW/25 kW

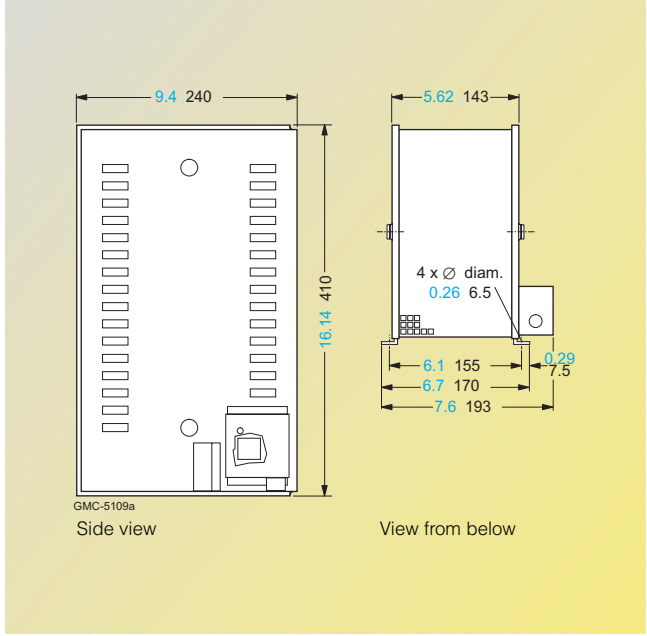



Fig. 7/7
Pulsed resistor 1.5 kW/25 kW

Dimension in inches
Dimension in mm

## Hose (pipe) cooling I/RF and power modules, single module and 2-tier configuration

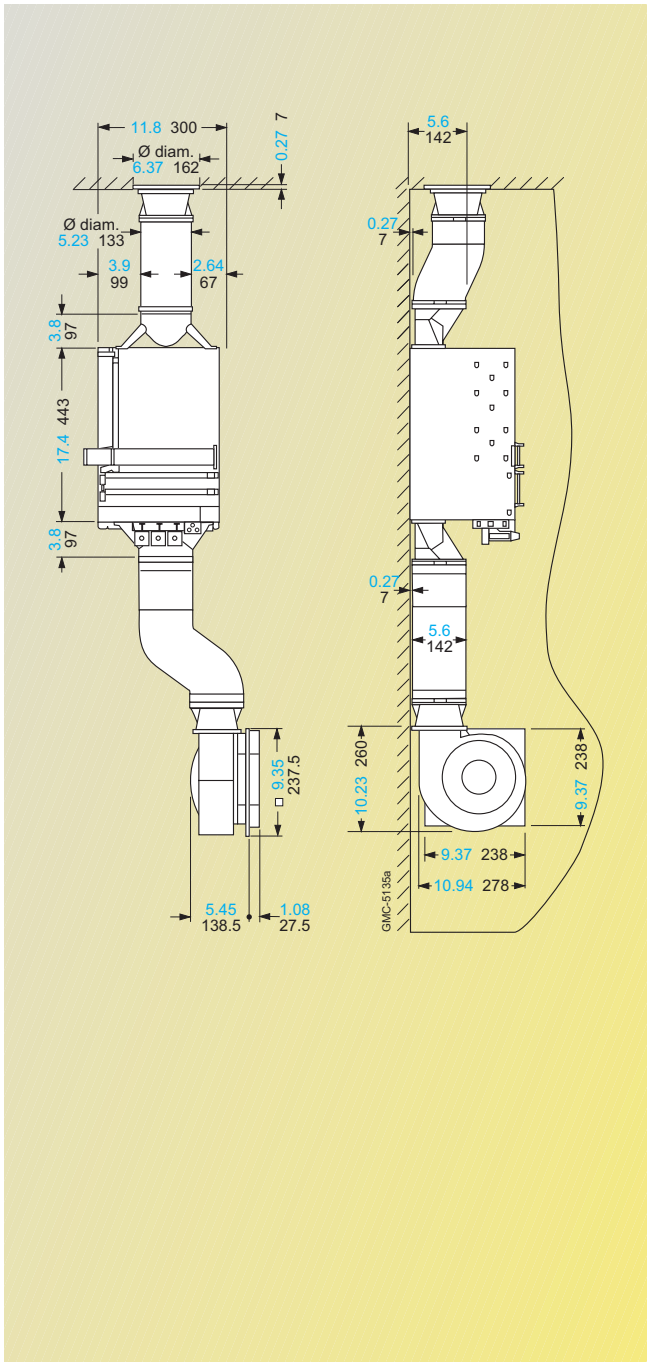



Fig. 7/8
**Hose (pipe) cooling single module**
for 11.88 in (300 mm) modules without shield terminal plates
Notes: Maximum overall length of hose: 78.74 in (2000 mm)
Minimum bending radius of hose: 4.92 in (125 mm)

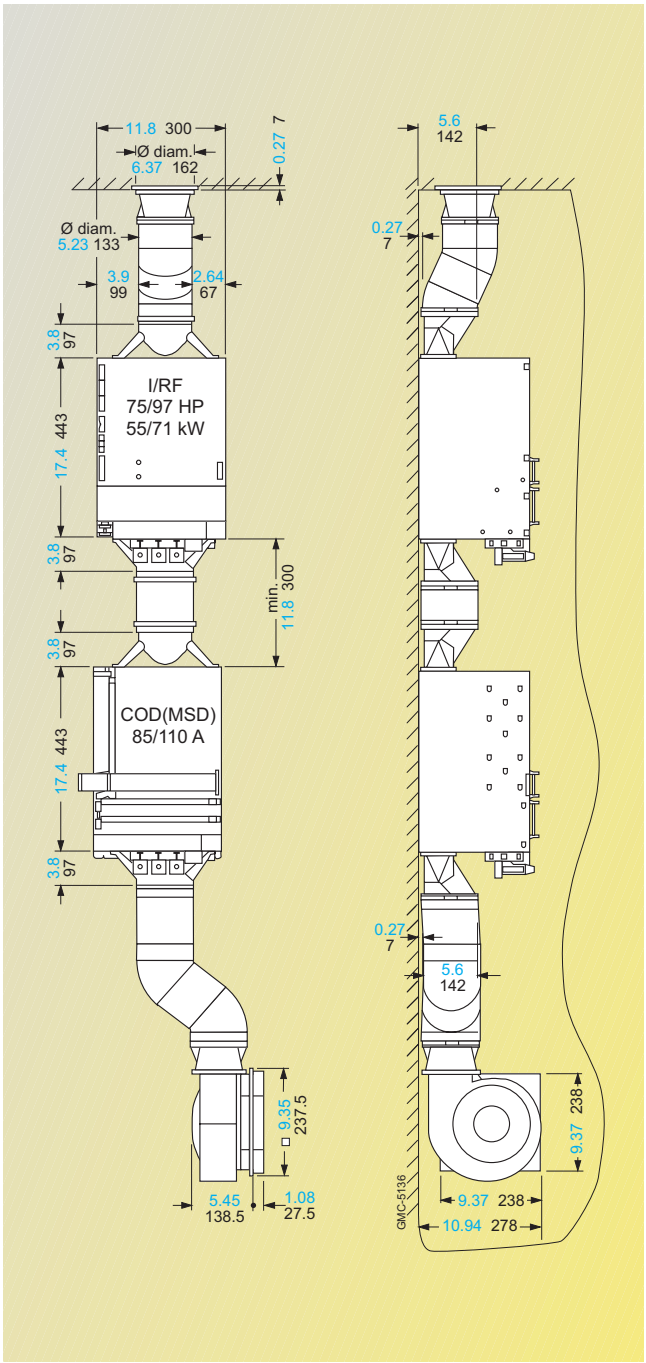



Fig. 7/9
**Hose (pipe) cooling 2-tier configuration**
for 11.88 in (300 mm) modules without shield terminal plates
Notes: Maximum overall length of hose: 78.74 in (2000 mm)
Minimum bending radius of hose: 4.92 in (125 mm)

Dimension in inches
Dimension in mm

## Mains filters

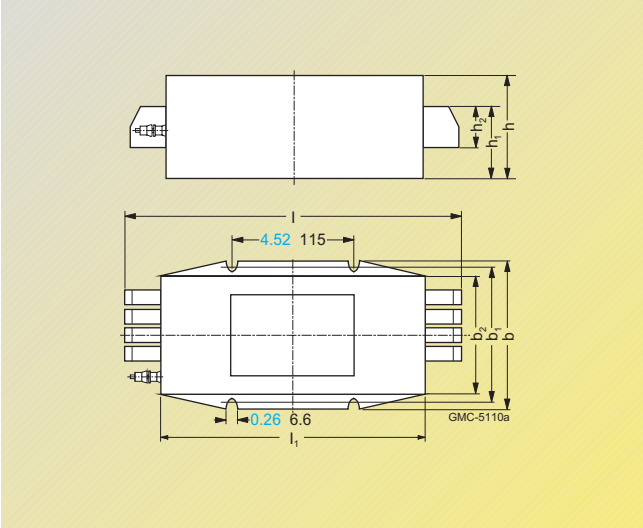



Fig. 7/10

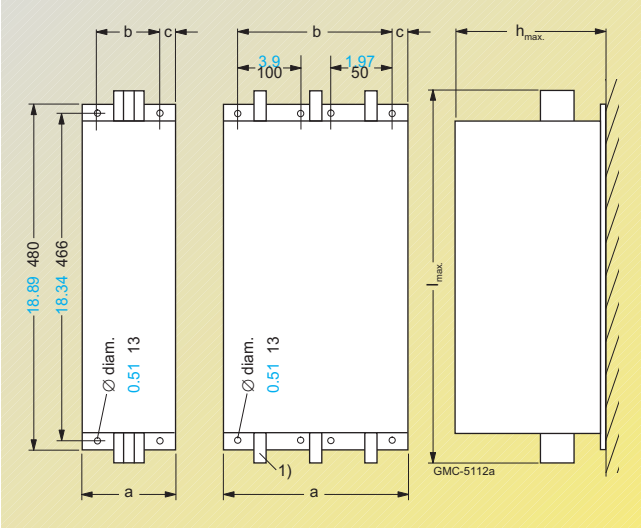



Fig. 7/11

| For OI module | Dimensions in (mm) b max. | $b_1$ | $b_2$ max. | h max. | $h_1$ | $h_2$ | l max. | $l_1$ max. |
|---|---|---|---|---|---|---|---|---|
| 6.5 HP (5 kW) | 6.29 (160) | 5.5 (140) | 5.11 (130) | 3.35 (85) | 1.40 (36) | 0.83 (21) | 8.1 (205) | 6.89 (175) |
| 13.5 HP (10 kW) | 6.29 (160) | 5.5 (140) | 5.11 (130) | 3.74 (95) | 1.8 (46) | 1.14 (29) | 11.4 (290) | 9.25 (235) |
| 38 HP (28 kW) | 6.73 (171) | 6.1 (155) | 5.55 (141) | 5.55 (141) | 3.82 (97) | 2.17 (55) | 13.7 (348) | 10.28 (261) |

| For I/RF module | Dimensions in (mm) a | b | c | h max. | l max. |
|---|---|---|---|---|---|
| 22 HP (16 kW) | 5.11 (130) | 3.9 (100) | 0.59 (15) | 5.89 (149,5) | 19.25 (489) |
| 49 HP (36 kW) | 5.11 (130) | 3.9 (100) | 0.59 (15) | 9.63 (244,5) | 20.7 (526) |
| 75 HP (55 kW) | 5.11 (130) | 3.9 (100) | 0.59 (15) | 11.0 (279,5) | 20.7 (526) |
| 109 HP (80 kW) | 7.9 (200) | 5.9 (150) | 0.98 (25) | 11.0 (279,5) | 21.2 (539) |
| 160 HP (120 kW) | 11.8 (300) | 9.84 (250) | 0.98 (25) | 11.0 (279,5) | 20.87 (530) |

## Commutating reactors

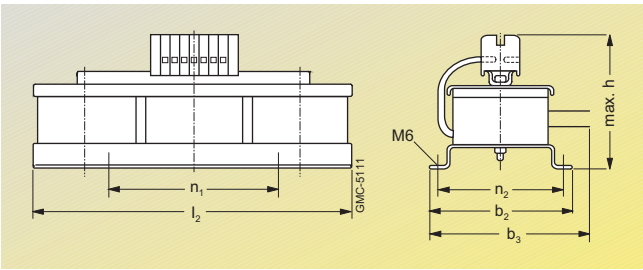



Fig. 7/12

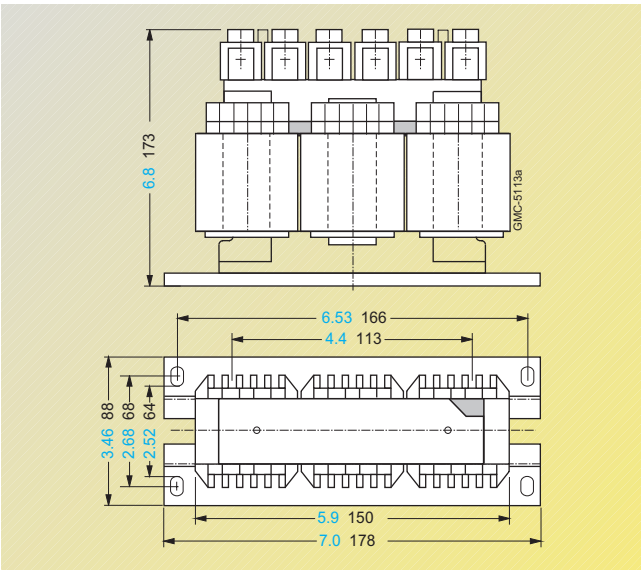



Fig. 7/13
Commutating reactor 38 HP/28 kW

| Rated supply power | Order No. 6SN 1111-0AA00- | Dimensions in (mm) $b_2$ | $b_3$ | h | $l_2$ | $n_1$ | $n_2$ | Screw connection terminals max. $mm^2$ |
|---|---|---|---|---|---|---|---|---|
| 22 HP (16 kW) | -0BA1 | 5.9 (150) | – (–) | 5.71 (145) | 13.0 (330) | 6.9 (175) | 5.35 (136) | 16 |
| 49 HP (36 kW) | -0CA1 | 5.9 (150) | – (–) | 9.06 (230) | 13.0 (330) | 6.9 (175) | 5.35 (136) | 50 |
| 75 HP (55 kW) | -0DA1 | 5.9 (150) | – (–) | 11.0 (280) | 13.0 (330) | 6.9 (175) | 5.35 (136) | 70 |
| 109 HP (80 kW) | -1EA0 | 6.7 (170) | 8.86 (225) | 7.9 (200) | 15.0 (380) | 12.8 (325) | 6.14 (156) | 2) |
| 160 HP (120 kW) | -1FA0 | 6.7 (170) | 8.86 (225) | 11.8 (300) | 15.0 (380) | 12.8 (325) | 6.14 (156) | 2) |

1) Flat-type screw terminal with 0.433 in (11 mm) diameter.

2) Flat-type screw terminal with 0.355 in (9 mm) diameter.

Dimension in inches
Dimension in mm

## Modules 1.97 to 11.8 in (50 to 300 mm), internal cooling

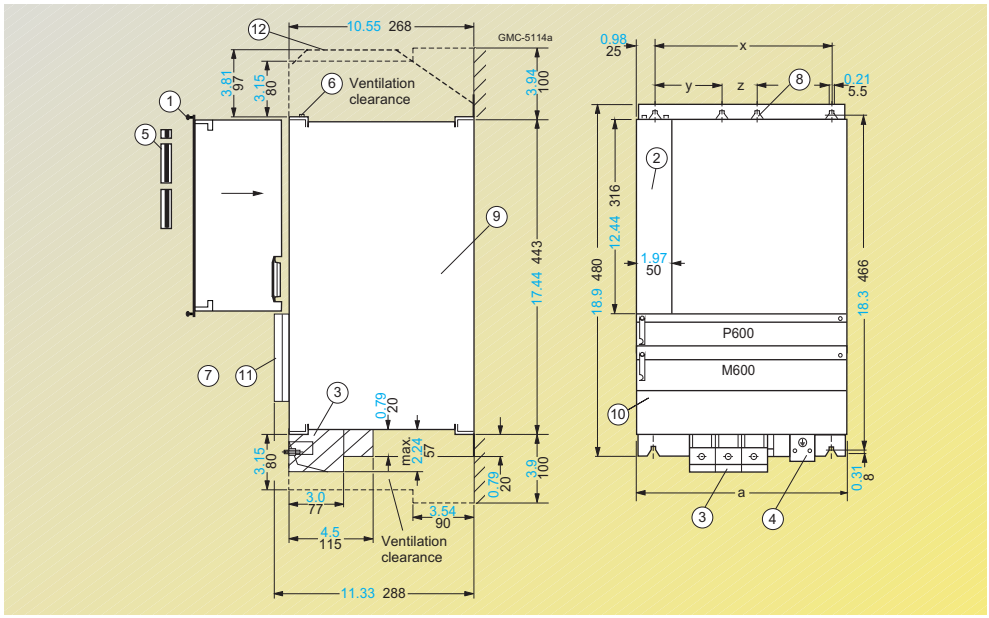



Fig. 7/14

| Dimensions in (mm) a | x | y | z | GND (PE) | Max. conductor cross-section U, V, W | X131 |
|---|---|---|---|---|---|---|
| 1.97 (50) | – | – | – | M5 | 4 or 6 mm² 1)/M 3 | 16 mm²/M 4 |
| 3.9 (100) | 1.97 (50) | – | – | M5 | 10 or 16 mm² 1)/M 4 | 16 mm²/M 4 |
| 5.9 (150) | 3.9 (100) | – | – | M6 | 50 mm²/M 6 | – |
| 7.9 (200) | 5.9 (150) | – | – | M6 | 50 mm²/M 6 | 16 mm²/M 4 |
| 11.8 (300) | 9.84 (250) | 3.9 (100) | 1.97 (50) | M6 | 95 mm²/M 8 | 16 mm²/M 4 |

1) Only applicable with plug connector

① Control board inserted screwed in
Attention! Screw in to ensure the galvanic contact for GND (PE)- and encoder cable shield
② Terminal block area
③ Terminal U, V, W, X131
④ GND (PE)-connection
⑤ Combicon-terminal (plugged for delivery)
⑥ Additional connection possible for cable screening M 5 x 10 (encoder, reference value)
⑦ Cover clicked in
⑧ Borehole for screwing thread M 5 or 10 – 24 UNC-2A, 10 – 32 UNF-2A
⑨ Material: Metal sheet DIN EN 10 143 FE P0 3G Z140 MB-0-1.5
⑩ Front cover: plastic
⑪ Cover: plastic
⑫ Hot-air deffection metal sheet (Option with 10 kW-Modul)

Adhere to following tightening torques for module assembly
Screws M 3: 7 inlb ( 0.8 Nm)
Screws M 4: 16 inlb ( 1.8 Nm)
Screws M 5: 26 inlb ( 3.0 Nm)
Screws M 6: 52 inlb ( 6.0 Nm)
Screws M 8: 112 inlb (13 Nm)

## Modules 11.8 in (300 mm), internal cooling with fan

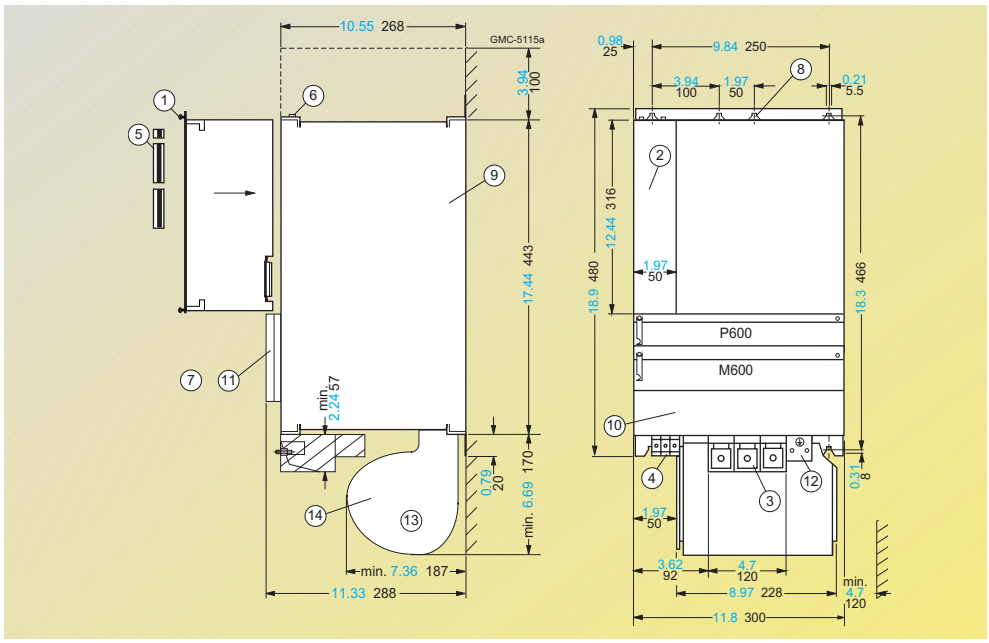



Fig. 7/15

| Module | Max. conductor cross-section U, V, W | L1, L2, X131 |
|---|---|---|
| 108/141 HP (80/104 kW) | 95 mm²/M 8 | 16 mm²/M 4 |
| 163/212 HP (120/156 kW) | 150 mm²/M 10 | 16 mm²/M 4 |
| 300 A | 95 mm²/M 8 | – |
| 400 A | 150 mm²/M 10 | – |

① Control board inserted screwed in
Attention! Screw in to ensure the galvanic contact for GND (PE)- and encoder cable shield
② Terminal block area
③ Terminal U, V, W, X131
④ Terminal L1, L2, X131
⑤ Combicon-terminal (plugged for delivery)
⑥ Additional connection possible for cable screening M 5 x 10 (encoder, reference value)
⑦ Cover clicked in
⑧ Borehole for screwing thread M 5 or 10 – 24 UNC-2A, 10 – 32 UNF-2A
⑨ Material: Metal sheet DIN EN 10 143 FE P0 3G Z140 MB-0-1.5
⑩ Front cover: plastic
⑪ Cover: plastic
⑫ GND (PE)-connection
⑬ Blower
⑭ Fan weight: 4 kg

Adhere to following tightening torques for module assembly
Screws M 3: 7 inlb ( 0.8 Nm)
Screws M 4: 16 inlb ( 1.8 Nm)
Screws M 5: 26 inlb ( 3.0 Nm)
Screws M 6: 52 inlb ( 6.0 Nm)
Screws M 8: 112 inlb (13 Nm)
Screws M 10: 173 inlb (20 Nm)

Dimension in inches
Dimension in mm

## Hose (pipe) cooling, single module

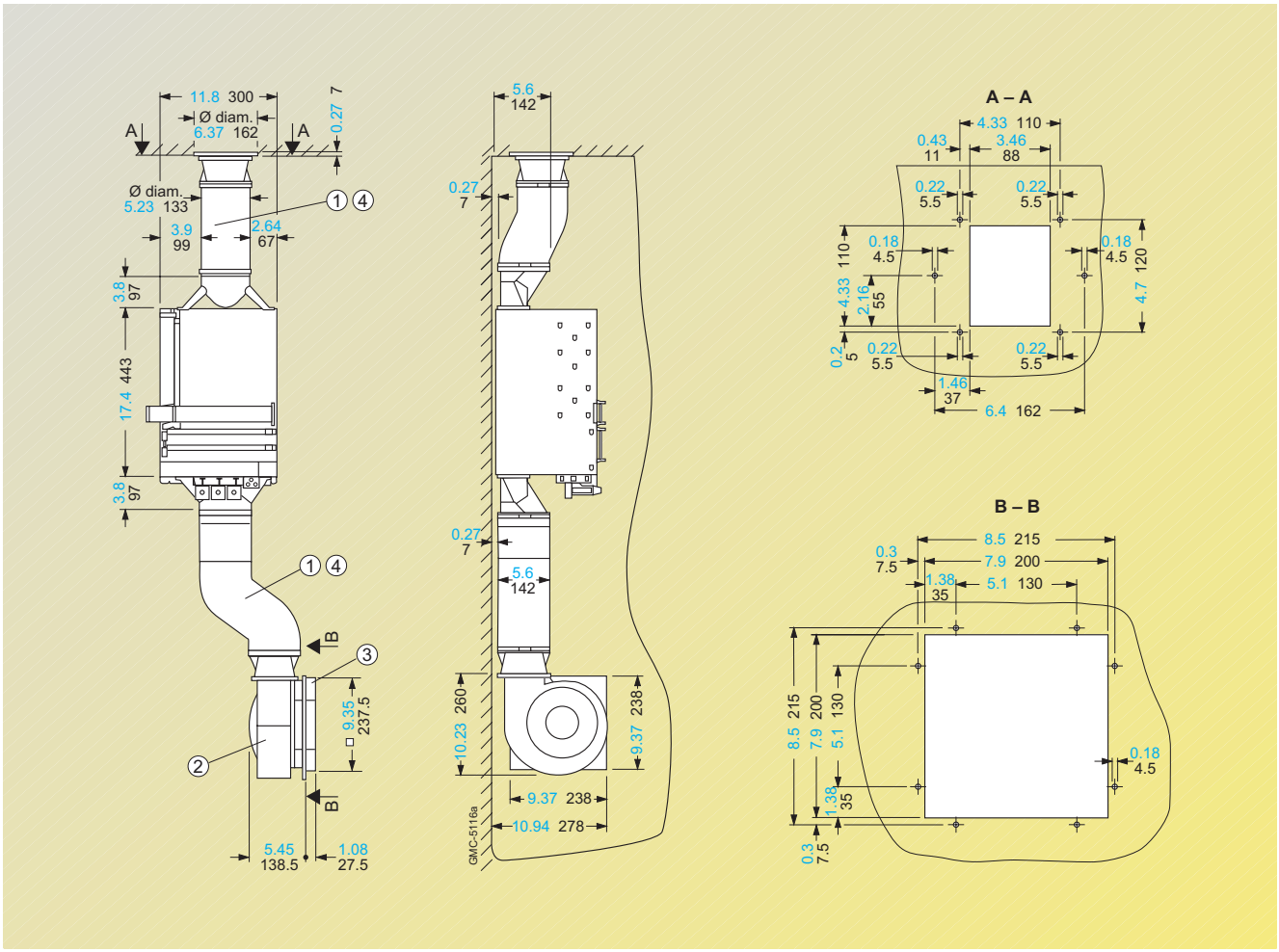



Fig. 7/16

① Maximum total length for hose: 78.74 in (2 m)
② Fan weight: 11 lb (5 kg)
③ Degree of protection for filter: IP 54
④ Minimum bending radius for hose: R = 4.9 in (125 mm)

Adhere to following tighting torques for module assembly
Screws M 3: 7 inlb (0.8 Nm)
Screws M 4: 16 inlb (1.8 Nm)
Screws M 5: 26 inlb (3 Nm)
Screws M 6: 52 inlb (6 Nm)

Dimension in inches
Dimension in mm

## Hose (pipe) cooling, 2-tier configuration

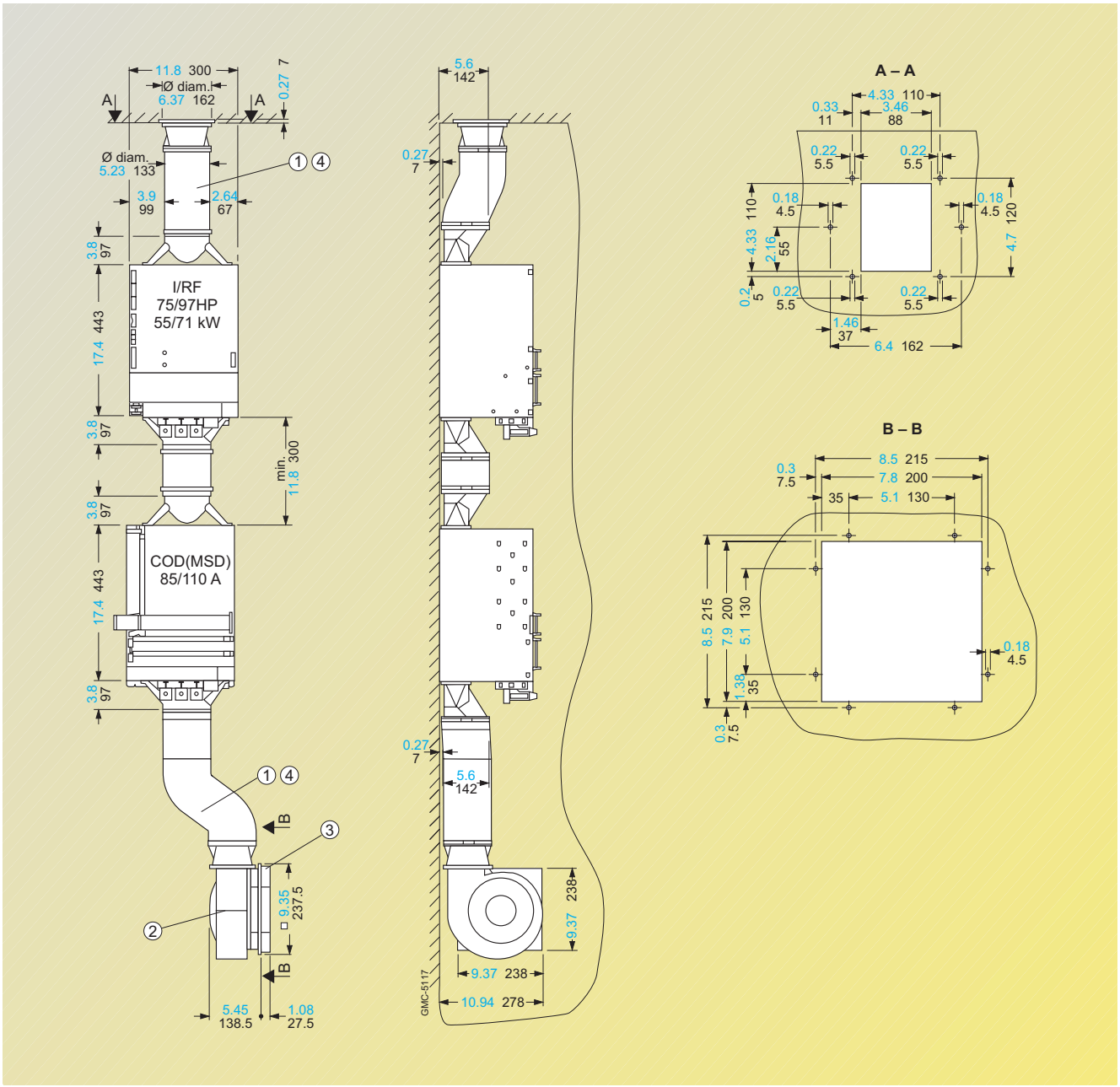


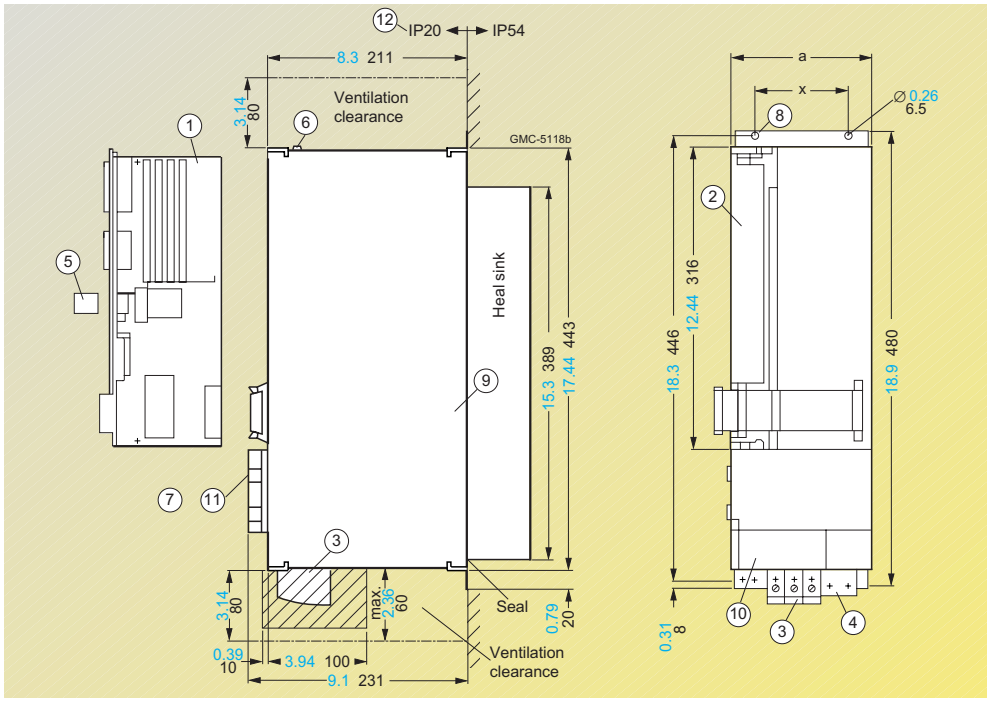

Fig. 7/17

① Maximum total length for hose: 78.74 in (2 m)
② Fan weight: 11 lb (5 kg)
③ Degree of protection for filter: IP 54
④ Minimum bending radius for hose: R = 4.9 in (125 mm)

Adhere to following tighting torques for module assembly
Screws M 3: 7 inlb (0.8 Nm)
Screws M 4: 16 inlb (1.8 Nm)
Screws M 5: 26 inlb (3 Nm)
Screws M 6: 52 inlb (6 Nm)

Dimension in inches
Dimension in mm

## Modules 1.97 to 7.9 in (50 to 200 mm), external cooling




① Control board inserted screwed in
Attention! Screw in to ensure the galvanic contact for GND (PE)- and encoder cable shield
② Terminal block area
③ Terminal U, V, W, X131
④ GND (PE)-connection
⑤ Combicon-terminal (plugged for delivery) (Not included in modules with pulse-interface)
⑥ Additional connection possible for cable screening M 5 x 10 (encoder, reference value)
⑦ Cover clicked in
⑧ Borehole for screwing thread M 5 or 10 – 24 UNC-2A, 10 – 32 UNF-2A
⑨ Material: Metal sheet DIN EN 10 143 FE P0 3G Z140 MB-0-1.5
⑩ Front cover: plastic
⑪ Cover: plastic
⑫ Modules with pulse interface: IP 00

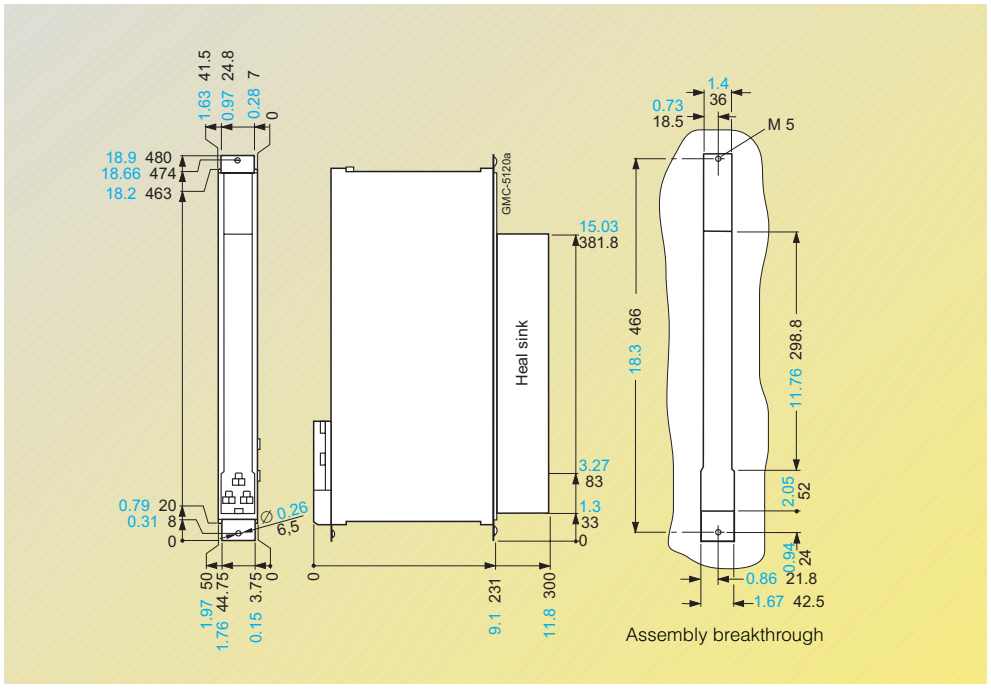
Adhere to following tightening torques for module assembly
Screws M 3: 7 inlb (0.8 Nm)
Screws M 4: 16 inlb (1.8 Nm)
Screws M 5: 26 inlb (3.0 Nm)

Fig. 7/18

| Dimensions in (mm) a | x | GND (PE) | Max. conductor cross-section U, V, W | X131 |
|---|---|---|---|---|
| 1.97 (50) | – | M 5 | 4 or 6 mm² 1)/M 3 | 16 mm²/M 4 |
| 3.9 (100) | 1.97 (50) | M 5 | 10 or 16 mm² 1)/M 4 | 16 mm²/M 4 |
| 5.9 (150) | 3.9 (100) | M 6 | 50 mm²/M 6 | – |
| 7.9 (200) | 5.9 (150) | M 6 | 50 mm²/M 6 | 16 mm²/M 4 |

1) Only applicable with plug connector

## Power module 1-axis, 1.97 in (50 mm), external cooling




Adhere to following tightening torques for module assembly
Screws M 3: 7 inlb (0.8 Nm)
Screws M 4: 16 inlb (1.8 Nm)
Screws M 5: 26 inlb (3.0 Nm)
Screws M 6: 52 inlb (6.0 Nm)

Fig. 7/19

Dimension in inches
Dimension in mm

## Power module 2-axis, 1.97 in (50 mm), external cooling

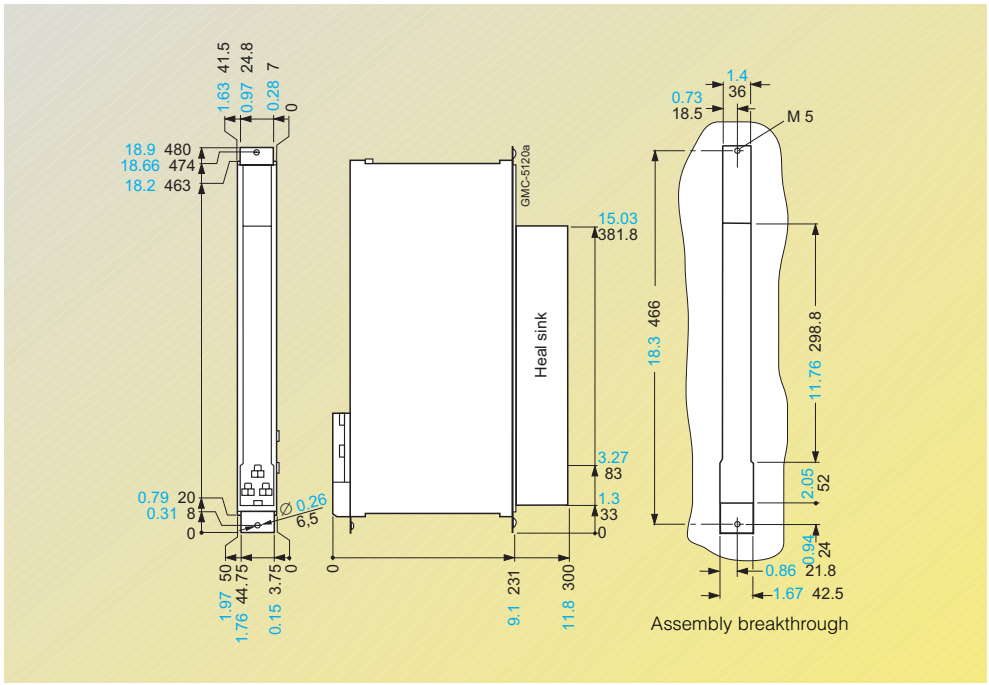



Fig. 7/20

Adhere to following tightening torques for module assembly
Screws M 3: 7 inlb (0.8 Nm)
Screws M 4: 16 inlb (1.8 Nm)
Screws M 5: 26 inlb (3.0 Nm)
Screws M 6: 52 inlb (6.0 Nm)

## Power module 1-axis, 3.9 in (100 mm), external cooling

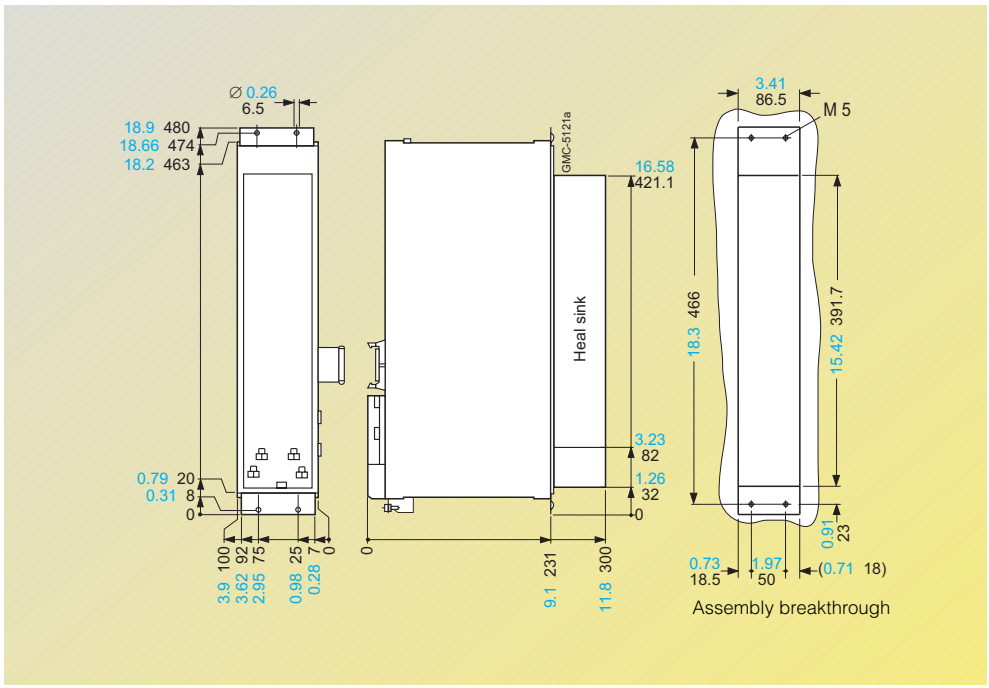


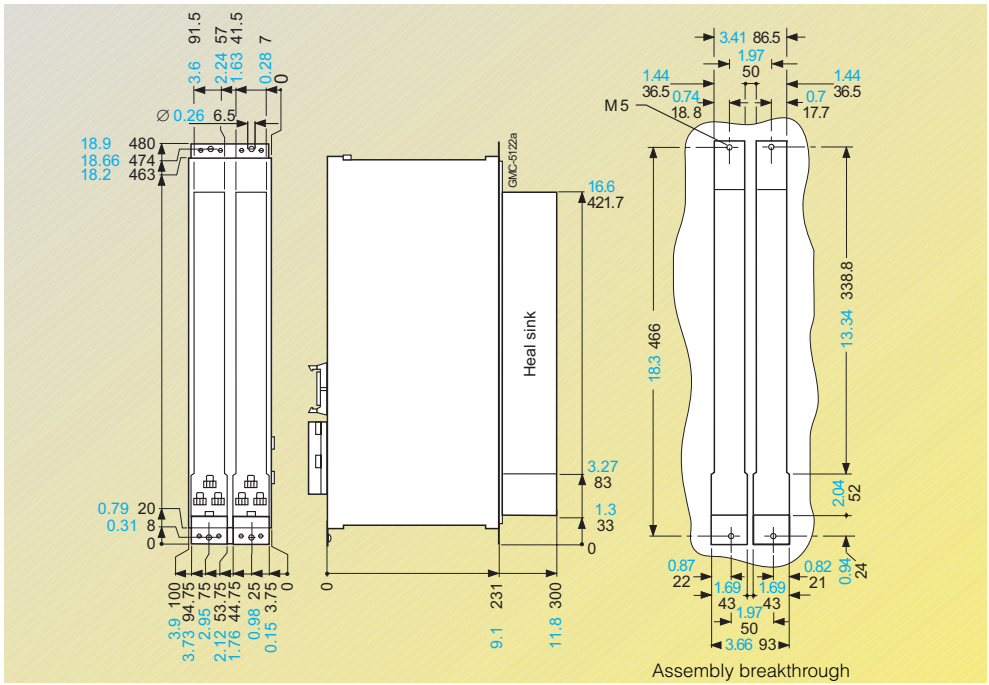

Fig. 7/21

Adhere to following tightening torques for module assembly
Screws M 3: 7 inlb (0.8 Nm)
Screws M 4: 16 inlb (1.8 Nm)
Screws M 5: 26 inlb (3.0 Nm)
Screws M 6: 52 inlb (6.0 Nm)

7

Dimension in inches
Dimension in mm

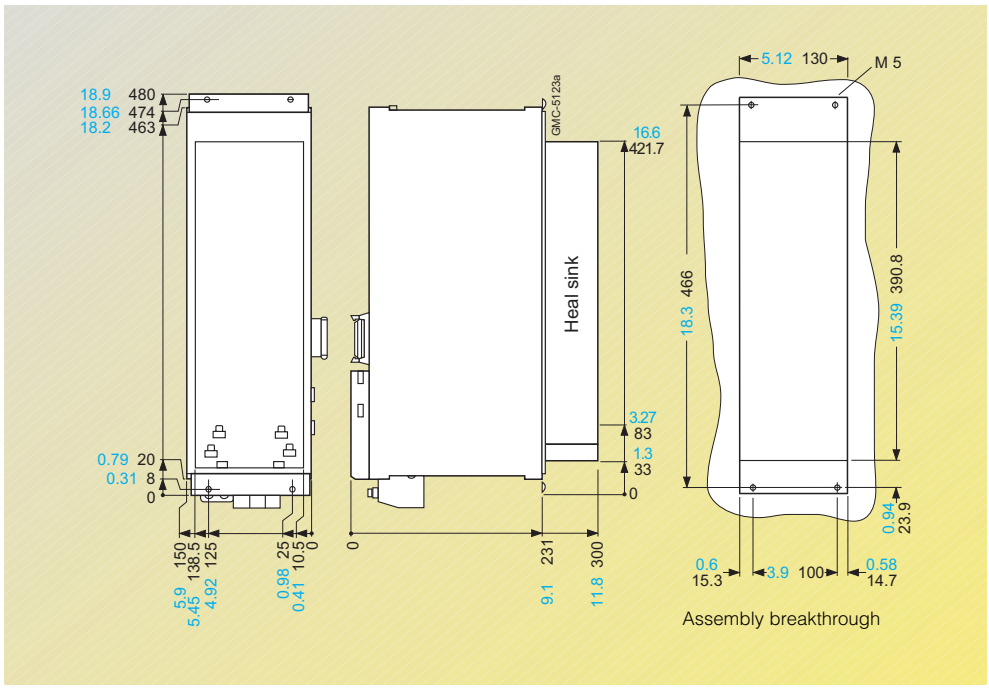
## Power module 2-axis, 3.9 in (100 mm), external cooling




Adhere to following tightening torques for module assembly
Screws M 3: 7 inlb (0.8 Nm)
Screws M 4: 16 inlb (1.8 Nm)
Screws M 5: 26 inlb (3.0 Nm)
Screws M 6: 52 inlb (6.0 Nm)

Fig. 7/22

## Power module 1-axis, 5.9 in (150 mm), external cooling




Adhere to following tightening torques for module assembly
Screws M 3: 7 inlb (0.8 Nm)
Screws M 4: 16 inlb (1.8 Nm)
Screws M 5: 26 inlb (3.0 Nm)
Screws M 6: 52 inlb (6.0 Nm)

Fig. 7/23

Dimension in inches
Dimension in mm

## Infeed module 1-axis, 7.9 in (200 mm), external cooling

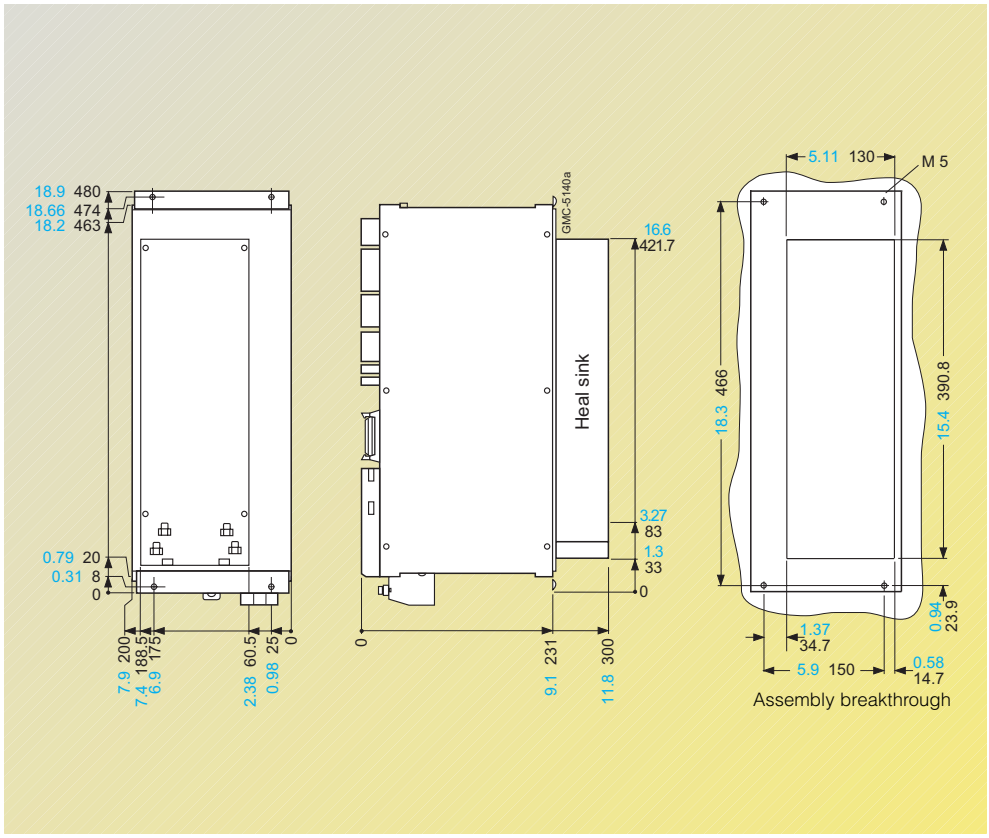



Fig. 7/24

Adhere to following tightening torques for module assembly
Screws M 3: 7 inlb (0.8 Nm)
Screws M 4: 16 inlb (1.8 Nm)
Screws M 5: 26 inlb (3.0 Nm)
Screws M 6: 52 inlb (6.0 Nm)

7

Dimension in inches
Dimension in mm

## Infeed and power modules 1-axis, 11.8 in (300 mm), external cooling with fan

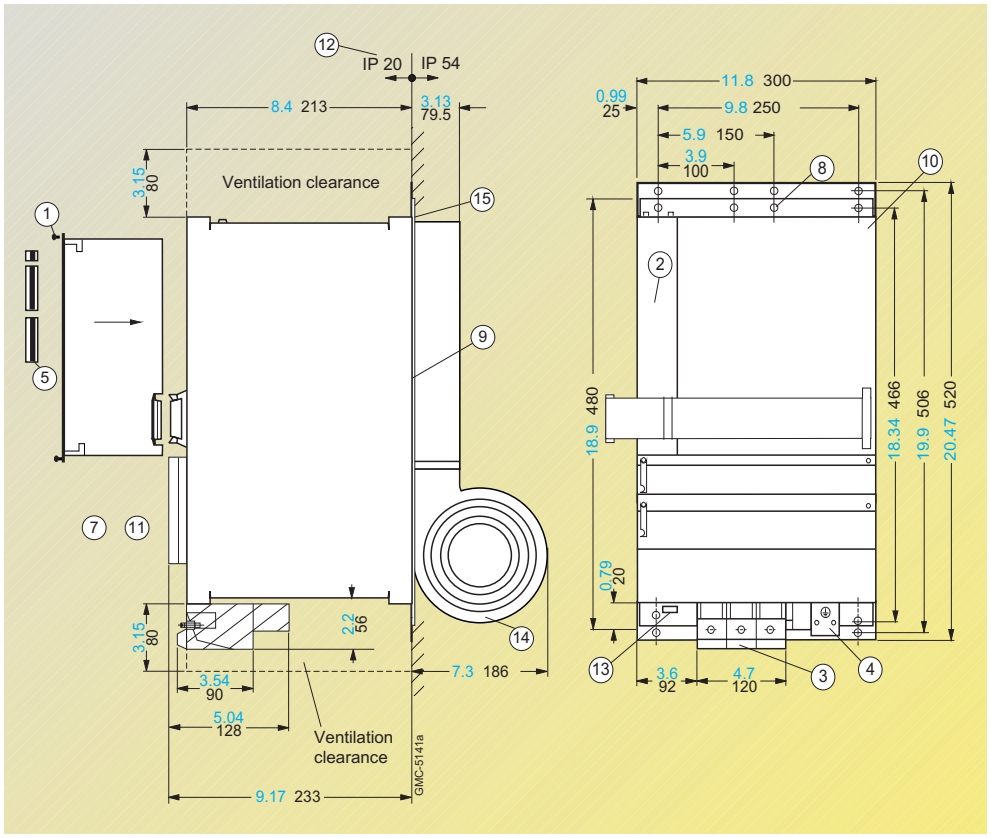



Fig. 7/25

| Module | Max. conductor cross-section U, V, W | L1, L2, X131 |
|---|---|---|
| 75 HP (55 kW) | 95 mm²/M 8 | 16 mm²/M 4 |
| 109 HP (80 kW) | 95 mm²/M 8 | 16 mm²/M 4 |
| 160 HP (120 kW) | 150 mm²/M 10 | 16 mm²/M 4 |
| 200 A | 95 mm²/M 8 | – |
| 300 A | 95 mm²/M 8 | – |
| 400 A | 150 mm²/M 10 | – |

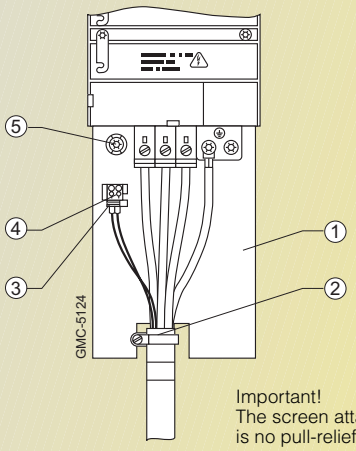
① Control board inserted screwed in
Attention! Screw in to ensure the galvanic contact for GND (PE)- and encoder cable shield
② Terminal block area
③ Terminal U, V, W, X131
④ GND (PE)-connection
⑤ Combicon-terminal (plugged for delivery) (Not included in modules with pulse-interface)
⑥ Additional connection possible for cable screening M 5 x 10 (encoder, reference value)
⑦ Cover clicked in
⑧ Borehole for screwing thread M 5 or 10 – 24 UNC-2A, 10 – 32 UNF-2A
⑨ Material: Metal sheet DIN EN 10 143 FE P0 3G Z140 MB-0-1.5
⑩ Front cover: plastic
⑪ Cover: plastic
⑫ Modules with pulse interface: IP 00
⑬ Terminal L1, L2, X131
⑭ Fan weight: 4 kg
⑮ Mounting frame 11.8 in (300 mm)

Adhere to following tightening torques for module assembly
Screws M 3: 7 inlb (0.8 Nm)
Screws M 4: 16 inlb (1.8 Nm)
Screws M 5: 26 inlb (3.0 Nm)
Screws M 6: 52 inlb (6.0 Nm)
Screws M 8: 112 inlb (13 Nm)
Screws M 10: 173 inlb (20 Nm)

Dimension in inches
Dimension in mm

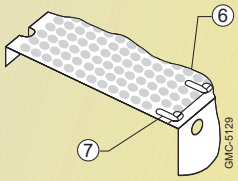
## EMC Engineering guidelines



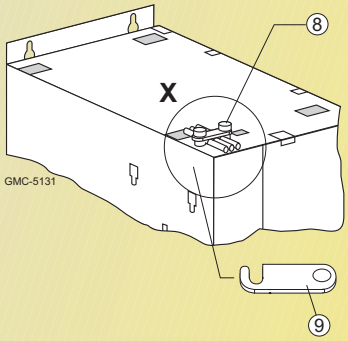


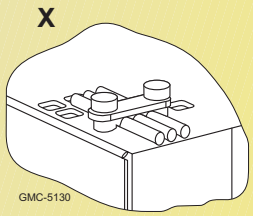

Important!
The screen attachment
is no pull-relief

Fitting:
The shield plate engages
in the module grille and is
secured with screws




seat for cable screens
(e.g. control line for
function terminals)




① Shield plate

② Hose-clamp for shield

③ Plug connector for motor brake

Plug connectors and hose-clamp are included with SIEMENS preassembled, shielded motor lead:
Order No.
6FX2002-5DA□□-1□□0
6FX2002-5CA□□-1□□0
6FX4002-5DA□□-1□□0
6FX4002-5CA□□-1□□0

④ Screw M 2.5 x 8

⑤ Screw M 5 for module attachement

⑥ Shield plate

⑦ Hook for engaging in grille

⑧ M 5 x 10
Important! Screws must not be overlength

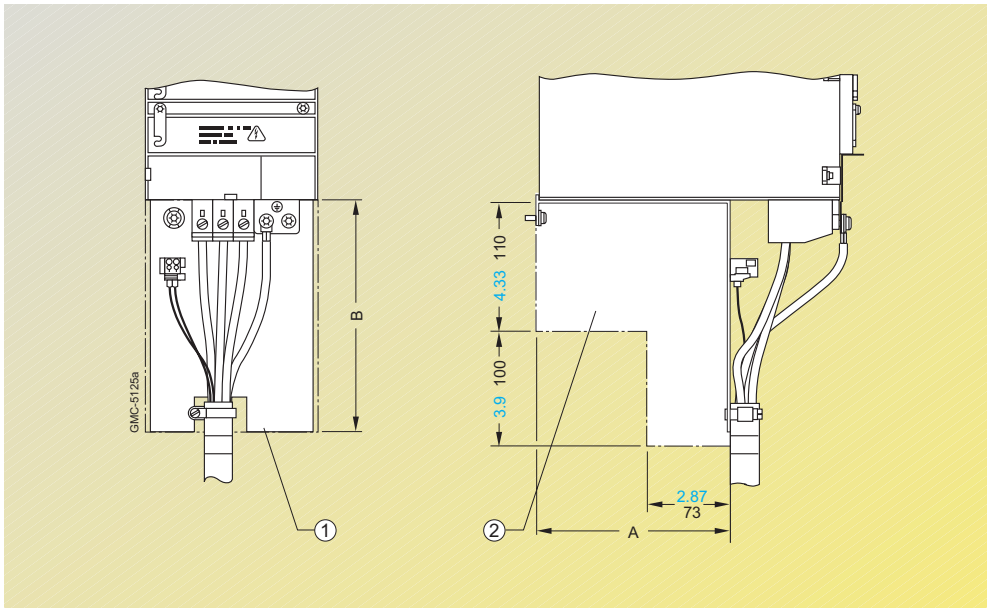
⑨ Screen connecting rail
Order No.: 6SN11 62-0FA00-0AA0

The hose-clamps match the outside diameter of the cable screen.
The details are given in the table below.

| Conductor cross-section | Hose-clamp for shield is included with SIEMENS preassembled motor lead |
|---|---|
| 4 x 1.5 $mm^2$<br>4 x 1.5 $mm^2$ + 2 x 1 $mm^2$ | Hose-clamp DIN 3017-AL-8-16 WI-I |
| 4 x 2.5 $mm^2$ | Hose-clamp DIN 3017-AL-8-16 WI-I |
| 4 x 2.5 $mm^2$ + 2 x 1 $mm^2$ | Hose-clamp DIN 3017-AL-12-20 WI-I |
| 4 x 4 $mm^2$<br>4 x 4 $mm^2$ + 2 x 1 $mm^2$ | Hose-clamp DIN 3017-AL-12-20 WI-I |
| 4 x 6 $mm^2$<br>4 x 6 $mm^2$ + 2 x 1 $mm^2$ | Hose-clamp DIN 3017-AL-16-25 WI-I |
| 4 x 10 $mm^2$<br>4 x 10 $mm^2$ + 2 x 1 $mm^2$ | Hose-clamp DIN 3017-AL-16-25 WI-I |
| 4 x 16 $mm^2$<br>4 x 16 $mm^2$ + 2 x 1 $mm^2$ | Hose-clamp DIN 3017-AL-16-25 WI-I |
| 4 x 25 $mm^2$ + 2 x 1,5 $mm^2$ | Hose-clamp DIN 3017-AS-25-40 WI-I |
| 4 x 35 $mm^2$ + 2 x 1,5 $mm^2$ | Hose-clamp DIN 3017-AS-25-40 WI-I |
| 4 x 50 $mm^2$ + 2 x 1,5 $mm^2$ | Hose-clamp DIN 3017-AS-32-50 WI-I |

Required tightening torques for module assembly
Screws M 3: 7 inlb (0.8 Nm)
Screws M 4: 16 inlb (1.8 Nm)
Screws M 5: 26 inlb (3.0 Nm)
Screws M 6: 52 inlb (6.0 Nm)

Fig. 7/26
Dimension in inches
Dimension in mm




① Shield plate
② Free space for cooling air

Fig. 7/27

| Module width<br>in (mm) | Shield plate Dimension<br>A<br>in (mm) | <br>B<br>in (mm) | <br><br>Order No. |
|---|---|---|---|
| 1.97 (50) | 5.04 (128) | 4.7 (120) | 6SN11 62-0EA00-0AA0 |
| | 2.8 (71) | 4.7 (120) | 6SN11 62-0EB00-0AA0 |
| 3.9 (100) | 7.0 (177.8) | 4.7 (120) | 6SN11 62-0EA00-0BA0 |
| | 4.4 (111) | 4.7 (120) | 6SN11 62-0EB00-0BA0 |
| 5.9 (150) | 6.6 (167.8) | 7.9 (200) | 6SN11 62-0EA00-0CA0 |
| | 4.2 (107.8) | 7.9 (200) | 6SN11 62-0EB00-0CA0 |
| 7.9 (200) | 6.6 (167.8) | 7.9 (200) | 6SN11 62-0EA00-0JA0 |
| | 4.2 (107.8) | 7.9 (200) | 6SN11 62-0EB00-0JA0 |
| 11.8 (300) | 7.4 (188.5) | 7.9 (200) | 6SN11 62-0EA00-0DA0 |
| | 5.1 (128.5) | 7.9 (200) | 6SN11 62-0EB00-0DA0 |
| | 7.5 (191.4) | 7.9 (200) | 6SN11 62-0EA00-0KA0 |

Dimension in inches
Dimension in mm

## POSMO A without gearbox

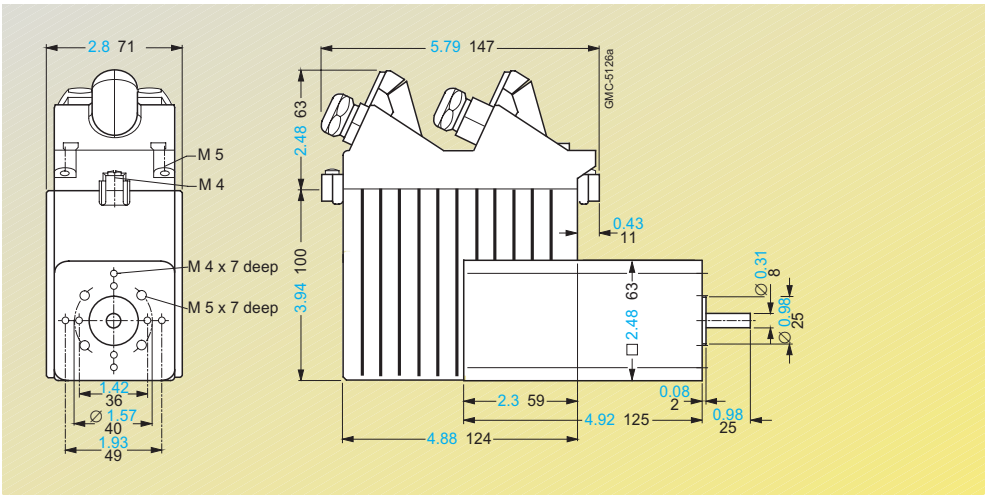



Fig. 7/28

Tightening torque
M 4: 16 inlb (1.8 Nm)
M 5: 26 inlb (3.0 Nm)

## Planetary gearbox

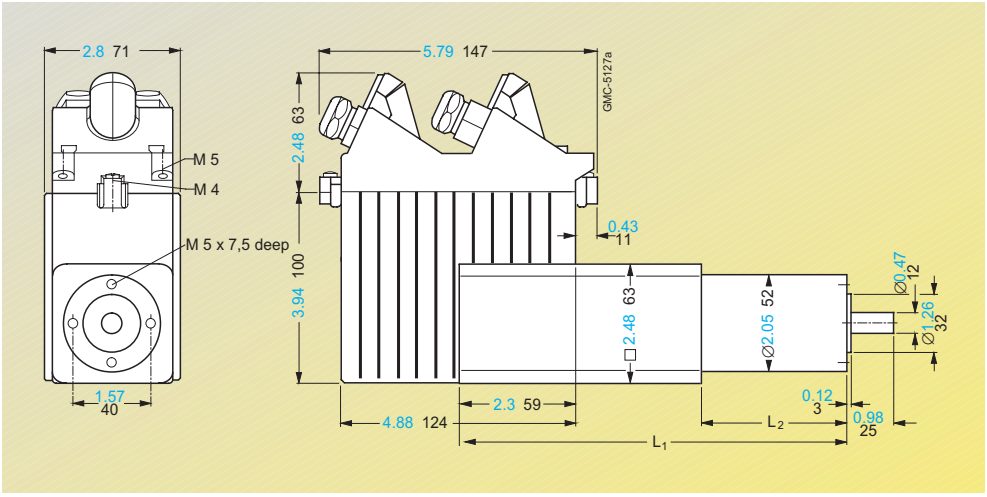



Fig. 7/29

Tightening torque
M 4: 16 inlb (1.8 Nm)
M 5: 26 inlb (3.0 Nm)

| Gear stages | $L_1$ in (mm) | $L_2$ in (mm) | Motor type |
|---|---|---|---|
| 1 | 6.9 (175) | 1.97 (50) | BG 63 x 55 |
| 2 | 7.5 (190.5) | 2.58 (65.5) | BG 63 x 55 |
| 3 | 8.0 (202.5) | 3.17 (80.5) | BG 63 x 55 |

Reduction ratio
4.5:1/20.25:1/36:1/126.56:1/
162:1/8:1

## Worm gearbox

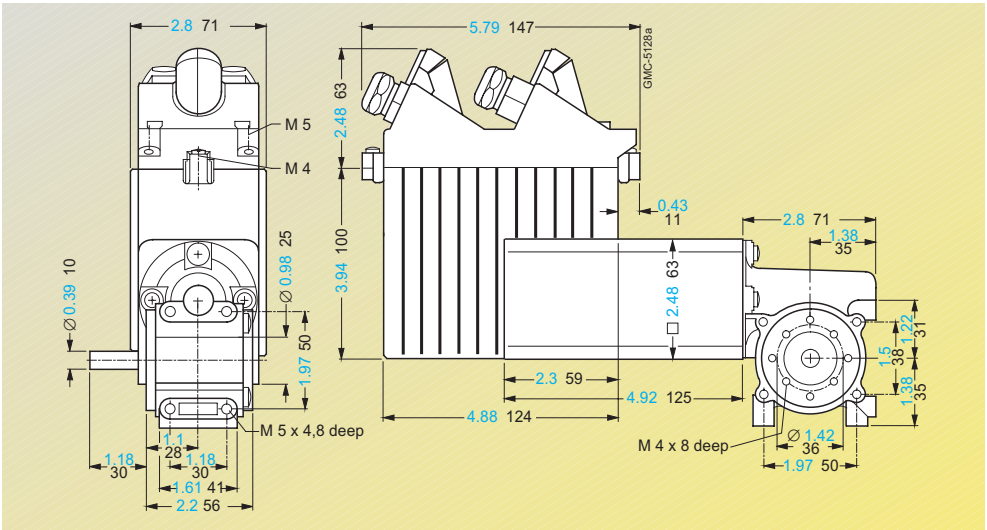
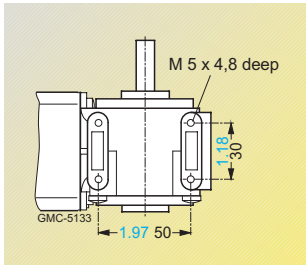



Fig. 7/30




Tightening torque
M 4: 16 inlb (1.8 Nm)
M 5: 26 inlb (3.0 Nm)

Reduction ratio
5:1/24:1

Dimension in inches
Dimension in mm

# SIMODRIVE 611 universal POSMO A

# Appendix


A/2 **Environment, Resources and Recycling, Certificate ISO 9001**

A/3 **Confirmation, typical system configuration**

A/4 **Subject index**

A/5 **Order number index**

A/6 **Conversion tables**


A

# Appendix

## Environment, Resources and Recycling, Certificate ISO 9001

SIMODRIVE POSMO A

SIMODRIVE 611 universal

Siemens AG has committed itself to protecting the environment and conserving valuable natural resources. This applies to both production and to the products we sell.

As early as the development phase, the possible impact of future products and systems on the environment is taken into consideration. Our aim is to prevent environmental pollution or, at least, reduce it to a minimum and, in doing so, look beyond existing regulations and legislation.

Below are some of the most important environment-related aspects which are taken into account in the design of SIMODRIVE.

The use of dangerous substances (such as arsenic, asbestos, beryllium, cadmium, CFC, halogens and many more) is avoided as early as the development phase.

Connections have been designed so that they are easy to service and materials are selected carefully with preference being given to those which can be recycled or disposed of without problem.

Materials for manufacturing purposes are identified in accordance with their recyclability. This applies, in particular, to components which contain unavoidable, hazardous materials. These components are installed or mounted in such a way that they can be easily separated, thus facilitating disposal in an environmentally-friendly manner. Wherever possible, recycled components are used.

Environmentally-compatible packaging materials (pressed board and PE foils) are used for shipping and storage. We also try to keep the amount of packaging material used to a minimum.

If possible we pack our products in reusable packaging.

We have already made preparations to enable the converters to be disposed of after use in accordance with the regulations governing the disposal of electronic equipment (not yet in force).

A

SIEMENS

EG-Konformitätserklärung
EC Declaration of Conformity
No. E002 V 03/09/99

Hersteller: Manufacturer: Siemens AG

Anschrift: Address: Siemens AG A&D MC
Frauenauracherstraße 80
91056 Erlangen

Produktbezeichnung: Product description: SINUMERIK 802D, 802S, 805, 805SM-P, 805SM-TW, 810, 810D
SIMATIC 820, 840C, 840CE, 840D, 840DE, FM NC
SIROTEC FM 353, FM 354, FM 357
SIMODRIVE RCM1D, RCM1P
610, 611, MCU, FM STEPDRIVE

**Das bezeichnete Produkt stimmt in der von uns in Verkehr gebrachten Ausführung mit den Vorschriften folgender Europäischer Richtlinie überein:**
**This product described above in the form as delivered is in conformity with the provisions of the following European Directives:**

89/336/EWG Richtlinie des Rates zur Angleichung der Rechtsvorschriften der Mitgliedstaaten über die elektromagnetische Verträglichkeit
(geändert durch 91/263/EWG, 92/31/EWG, 93/68/EWG und 93/97/EWG).
Council Directive on the approximation of the laws of the Member States relating to electromagnetic compatibility (amended by 91/263/EEC, 92/31/EEC, 93/68/EEC and 93/97/EEC)

Die Einhaltung dieser Richtlinie setzt einen EMV-gerechten Einbau der Produkte gemäß EMV-Aufbaurichtlinie für SINUMERIK SIROTEC, SIMODRIVE (Best. Nr. 6FC 5297-0AD30-0AP0) in die Gesamtanlage voraus. Anlagenkonfigurationen, bei der die Einhaltung dieser Richtlinie nachgewiesen wurde, sowie angewandte Normen, siehe:
For keeping the directive, it is required to install the products according to "EMC Mounting regulation for SINUMERIK, SIROTEC, SIMODRIVE" (Order No. 6FC 5297-0AD30-0AP0). For details of the system configurations, which meet the requirements of the directives, as well as for the standards applied see:

- Anhang A1 - A17 (Anlagenkonfigurationen / Komponenten) - Annex A1 - A17 (system configurations / components)
- Anhang B1 - B7 (Komponenten / Normen) - Annex B1 - B7 (components / standards)
- Anhang C - Annex C (standards)

Siemens AG
Erlangen, den 03.09.1999
R. Müller
Entwicklungsleitung
Name, Funktion / Name, function
Unterschrift / signature

K. Krause
Qualitätsmanagement
Name, Funktion / Name, function
Unterschrift / signature

Diese Erklärung bescheinigt die Übereinstimmung mit der genannten Richtlinie, ist jedoch keine Zusicherung von Eigenschaften. Die sicherheitsbezogene Dokumentation liegt der mitgelieferten Produktdokumentation bei. This declaration certifies the conformity to the specified directives but contains no assurance of properties. The safety documentation accompanying the product shall be considered in detail.

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**Anhang C zur EG-Konformitätserklärung Nr. E002 V 03/09/99**

C: Die Übereinstimmung der Produkte mit der Richtlinie des Rates 89/336/EWG wurde durch Überprüfung gemäß nachfolgender Produktnorm, Fachgrundnormen und der darin aufgelisteten Grundnormen nachgewiesen. Für die Produktkategorien SINUMERIK, SIMATIC, SIROTEC und SIMODRIVE gelten unterschiedliche Normenanforderungen.

**C1 Produktkategorie SINUMERIK*), SIMATIC, SIROTEC:**

Fachgrundnorm: EN 50081-2 Stand 8/93 1)
Grundnormen: EN 55011 2) — Prüfthema: Funkstörungen

Fachgrundnorm: EN 50082-2 Stand 3/95 3)
Grundnormen: EN 61000-4-3, ENV 50204, EN 61000-4-6, EN 61000-4-8, EN 61000-4-2, EN 61000-4-4
Prüfthema: 4) Hochfrequente Einstrahlung (amplitudenmoduliert) 5) Hochfrequente Einstrahlung (pulsmoduliert) 6) HF-Beströmung auf Leitungen 7) Magnetfelder 8) Statische Entladung 9) Schnelle Transienten (Burst)

*) außer SINUMERIK 810D

**C2 Produktkategorie SIMODRIVE, SINUMERIK 810D:**

Produktnorm: EN 61800-3 10)

**C3 Mitgeltende Normen:**

1) VDE 0839 Teil 81-2
2) VDE 0875 Teil 11
3) VDE 0839 Teil 82-2
4) VDE 0847 Teil 4-3, ENV 50140
5) VDE 0847 Teil 204
6) IEC 801-6, VDE 0847 Teil 4-6, IEV 1000-4-6, ENV 50141
7) VDE 0847 Teil 4-8, IEC 1000-4-8
8) VDE 0847 Teil 4-2, EN 60801 Teil 2, IEC 801-2
9) VDE 0843 Teil 2, VDE 0843 Teil 4, VDE 0847-Teil 4-4, IEC 801-4
10) VDE 0160 Teil 100

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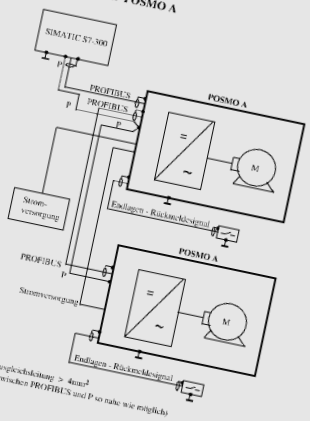
**Anhang A zur EG-Konformitätserklärung Nr. E002 V 03/09/99**

**A15: Typische Anlagenkonfiguration**
**SIMODRIVE POSMO A**




P = Potentialausgleichsleitung > 4mm²
(Abstand zwischen PROFIBUS und P so nahe wie möglich)

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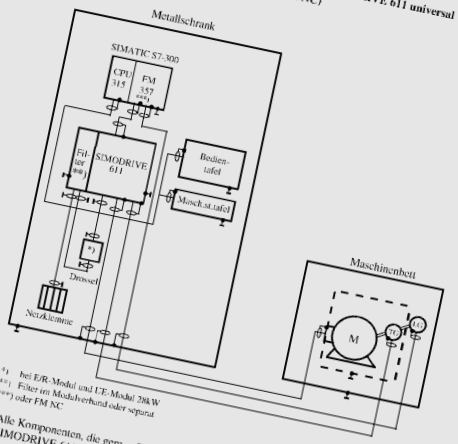
**Anhang A zur EG-Konformitätserklärung Nr. E002 V 03/09/99**

**A17: Typische Anlagenkonfiguration**
**SIMODRIVE 611 mit Regelungseinschub SIMODRIVE 611 universal und SIMATIC FM 357 (SINUMERIK FM NC)**




*1) bei E/R-Modul und LE-Modul 28kW
*2) Filter im Modulverbund oder separat
*3) oder FM NC

- Alle Komponenten, die gem Bestellunterlage f r den Anlagenverbund von SIMODRIVE 611 zugelassen sind, erf llen im Verbund die Richtlinie 89/336/EWG
- Normenkonformit t siehe Anhang C

**Hinweis:**
In der Skizze der Anlagenkonfiguration werden nur die grunds tzlichen Ma nahmen zur Einhaltung der Richtlinie 89/336/EWG einer typischen Anlagenkonfiguration aufgezeigt. Zus tzlich, besonders bei Abweichung von dieser Anlagenkonfiguration, sind die Installationshinweise f r EMV-gerechten Anlagenaufbau der Produktdokumentation und der EMV-Aufbaurichtlinie f r SINUMERIK, SIROTEC, SIMODRIVE (Bestell Nr.:6FC 5297-0AD30-0AP0) zu beachten.

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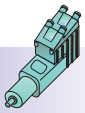
A

# Subject index

SIMODRIVE POSMO A



SIMODRIVE 611 universal

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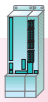
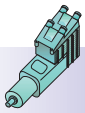


SIMODRIVE 611 universal



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## Rotary inertia (to convert from A to B, multiply by entry in table)

| A \ B | lb-in$^2$ | lb-ft$^2$ | lb-in-s$^2$ | lb-ft-s$^2$ slug-ft$^2$ | Kg-cm$^2$ | Kg-cm-s$^2$ | gm-cm$^2$ | gm-cm-s$^2$ | oz-in$^2$ | oz-in-s$^2$ |
|---|---|---|---|---|---|---|---|---|---|---|
| lb-in$^2$ | 1 | 6.94 x 10$^{-3}$ | 2.59 x 10$^{-3}$ | 2.15 x 10$^{-4}$ | 2.926 | 2.98 x 10$^{-3}$ | 2.92 x 10$^{3}$ | 2.984 | 16 | 4.14 x 10$^{-2}$ |
| lb-ft$^2$ | 144 | 1 | 0.3729 | 3.10 x 10$^{-2}$ | 421.40 | 0.4297 | 4.21 x 10$^{5}$ | 429.71 | 2304 | 5.967 |
| lb-in-s$^2$ | 386.08 | 2.681 | 1 | 8.33 x 10$^{-2}$ | 1.129 x 10$^{3}$ | 1.152 | 1.129 x 10$^{6}$ | 1.152 x 10$^{3}$ | 6.177 x 10$^{3}$ | 16 |
| lb-ft-s$^2$ slug-ft$^2$ | 4.63 x 10$^{3}$ | 32.17 | 12 | 1 | 1.35 x 10$^{4}$ | 13.825 | 1.355 x 10$^{7}$ | 1.38 x 10$^{4}$ | 7.41 x 10$^{4}$ | 192 |
| Kg-cm$^2$ | 0.3417 | 2.37 x 10$^{-3}$ | 8.85 x 10$^{-4}$ | 7.37 x 10$^{-5}$ | 1 | 1.019 x 10$^{-3}$ | 1000 | 1.019 | 5.46 | 1.41 x 10$^{-2}$ |
| Kg-cm-s$^2$ | 335.1 | 2.327 | 0.8679 | 7.23 x 10$^{-2}$ | 980.66 | 1 | 9.8 x 10$^{5}$ | 1000 | 5.36 x 10$^{3}$ | 13.887 |
| gm-cm$^2$ | 3.417 x 10$^{-4}$ | 2.37 x 10$^{-6}$ | 8.85 x 10$^{-7}$ | 7.37 x 10$^{-8}$ | 1 x 10$^{-3}$ | 1.01 x 10$^{-6}$ | 1 | 1.01 x 10$^{-3}$ | 5.46 x 10$^{-3}$ | 1.41 x 10$^{-5}$ |
| gm-cm-s$^2$ | 0.335 | 2.32 x 10$^{-3}$ | 8.67 x 10$^{-4}$ | 7.23 x 10$^{-5}$ | 0.9806 | 1 x 10$^{-3}$ | 980.6 | 1 | 5.36 | 1.38 x 10$^{-2}$ |
| oz-in$^2$ | 0.0625 | 4.34 x 10$^{-4}$ | 1.61 x 10$^{-4}$ | 1.34 x 10$^{-5}$ | 0.182 | 1.86 x 10$^{-4}$ | 182.9 | .186 | 1 | 2.59 x 10$^{-3}$ |
| oz-in-s$^2$ | 24.13 | .1675 | 6.25 x 10$^{-2}$ | 5.20 x 10$^{-3}$ | 70.615 | 7.20 x 10$^{-2}$ | 7.06 x 10$^{4}$ | 72.0 | 386.08 | 1 |

## Torque (to convert from A to B, multiply by entry in table)

| A \ B | lb-in | lb-ft | oz-in | N-m | Kg-cm | Kg-m | gm-cm | dyne-cm |
|---|---|---|---|---|---|---|---|---|
| lb-in | 1 | 8.333 x 10$^{-2}$ | 16 | 0.113 | 1.152 | 1.152 x 10$^{-2}$ | 1.152 x 10$^{3}$ | 1.129 x 10$^{6}$ |
| lb-ft | 12 | 1 | 192 | 1.355 | 13.825 | 0.138 | 1.382 x 10$^{4}$ | 1.355 x 10$^{7}$ |
| oz-in | 6.25 x 10$^{-2}$ | 5.208 x 10$^{-3}$ | 1 | 7.061 x 10$^{-3}$ | 7.200 x 10$^{-2}$ | 7.200 x 10$^{-4}$ | 72.007 | 7.061 x 10$^{4}$ |
| N-m | 8.850 | 0.737 | 141.612 | 1 | 10.197 | 0.102 | 1.019 x 10$^{4}$ | 1 x 10$^{7}$ |
| Kg-cm | 0.8679 | 7.233 x 10$^{-2}$ | 13.877 | 9.806 x 10$^{-2}$ | 1 | 10$^{-2}$ | 1000 | 9.806 x 10$^{5}$ |
| Kg-m | 86.796 | 7.233 | 1.388 x 10$^{3}$ | 9.806 | 100 | 1 | 1 x 10$^{5}$ | 9.806 x 10$^{7}$ |
| gm-cm | 8.679 x 10$^{-4}$ | 7.233 x 10$^{-5}$ | 1.388 x 10$^{-2}$ | 9.806 x 10$^{-5}$ | 1 x 10$^{-3}$ | 1 x 10$^{-5}$ | 1 | 980.665 |
| dyne-cm | 8.850 x 10$^{-7}$ | 7.375 x 10$^{-8}$ | 1.416 x 10$^{-5}$ | 10$^{-7}$ | 1.0197 x 10$^{-6}$ | 1.019 x 10$^{-8}$ | 1.019 x 10$^{-3}$ | 1 |

## Length (to convert from A to B, multiply by entry in table)

| A \ B | Inches | feet | cm | yd | mm | m |
|---|---|---|---|---|---|---|
| Inches | 1 | 0.0833 | 2.54 | 0.028 | 25.4 | 0.0254 |
| feet | 12 | 1 | 30.48 | 0.333 | 304.8 | 0.3048 |
| cm | 0.3937 | 0.03281 | 1 | 1.09 x 10$^{-2}$ | 10 | 0.01 |
| yd | 36 | 3 | 91.44 | 1 | 914.4 | 0.914 |
| mm | 0.03937 | 0.00328 | 0.1 | 1.09 x 10$^{-3}$ | 1 | 0.001 |
| m | 39.37 | 3.281 | 100 | 1.09 | 1000 | 1 |

## Mass (to convert from A to B, multiply by entry in table)

| A \ B | lb | oz | gm | slug |
|---|---|---|---|---|
| lb | 1 | 16 | 453.6 | 0.0311 |
| oz | 6.25 x 10$^{-2}$ | 1 | 28.35 | 1.93 x 10$^{-3}$ |
| gm | 2.205 x 10$^{-3}$ | 3.527 x 10$^{-3}$ | 1 | 6.852 x 10$^{-5}$ |
| slug | 32.17 | 514.8 | 1.459 x 10$^{4}$ | 1 |

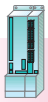
## Power (to convert from A to B, multiply by entry in table)

| A \ B | H.P. | Watts |
|---|---|---|
| H.P. (english) | 1 | 745.7 |
| (lb-in)(deg./sec) | 2.645 x 10$^{-6}$ | 1.972 x 10$^{-3}$ |
| (lb-in)(RPM) | 1.587 x 10$^{-5}$ | 1.183 x 10$^{-2}$ |
| (lb-ft)(deg./sec) | 3.173 x 10$^{-5}$ | 2.366 x 10$^{-2}$ |
| (lb-ft)(RPM) | 1.904 x 10$^{-4}$ | .1420 |
| Watts | 1.341 x 10$^{-3}$ | 1 |

## Rotation (to convert from A to B, multiply by entry in table)

| A \ B | RPM | rad/sec. | degrees/sec. |
|---|---|---|---|
| RPM | 1 | 0.105 | 6.0 |
| rad/sec. | 9.55 | 1 | 57.30 |
| degrees/sec. | 0.167 | 1.745 x 10$^{-2}$ | 1 |

A



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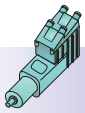

SIMODRIVE POSMO A

## Conversion tables

### Temperature conversion

| °F | °C | °C | °F |
|---|---|---|---|
| 0 | –17.8 | –10 | 14 |
| 32 | 0 | 0 | 32 |
| 50 | 10 | 10 | 50 |
| 70 | 21.1 | 20 | 68 |
| 90 | 32.2 | 30 | 86 |
| 98.4 | 37 | 37 | 98.4 |
| 212 | 100 | 100 | 212 |
| subtract 32 and multiply by $^5/_9$ | | multiply by $^9/_5$ and add 32 | |

### Force (to convert from A to B, multiply by entry in table)

| A \ B | lb | oz | gm | dyne | N |
|---|---|---|---|---|---|
| lb | 1 | 16 | 453.6 | $4.448 \times 10^5$ | 4.4482 |
| oz | .0625 | 1 | 28.35 | $2.780 \times 10^4$ | 0.27801 |
| gm | $2.205 \times 10^{-3}$ | 0.03527 | 1 | $1.02 \times 10^{-3}$ | N.A. |
| dyne | $2.248 \times 10^{-6}$ | $3.59 \times 10^{-5}$ | 980.7 | 1 | 0.00001 |
| N | 0.22481 | 3.5967 | N.A. | 100.000 | 1 |

### Mechanism Efficiencies

| | |
|---|---|
| Acme-screw with brass nut | ~ 0.35 – 0.65 |
| Acme-screw with plastic nut | ~ 0.50 – 0.85 |
| Ball-screw | ~ 0.85 – 0.95 |
| Chain and Sprocket | ~ 0.95 – 0.98 |
| Preloaded Ball-screw | ~ 0.75 – 0.85 |
| Spur or Bevel gears | ~ 0.90 |
| Timing Belts | ~ 0.96 – 0.98 |
| Worm Gears | ~ 0.45 – 0.85 |
| Helical Gear (1 reduction) | ~ 0.92 |

### Material Densities

| Material | lb-in$^3$ | gm-cm$^3$ |
|---|---|---|
| Aluminum | 0.096 | 2.66 |
| Brass | 0.299 | 8.30 |
| Bronze | 0.295 | 8.17 |
| Copper | 0.322 | 8.91 |
| Hard Wood | 0.029 | 0.80 |
| Soft Wood | 0.018 | 0.48 |
| Plastic | 0.040 | 1.11 |
| Glass | 0.079 – 0.090 | 2.2 – 2.5 |
| Titanium | 0.163 | 4.51 |
| Paper | 0.025 – 0.043 | 0.7 – 1.2 |
| Polyvinyl chloride | 0.047 – 0.050 | 1.3 – 1.4 |
| Rubber | 0.033 – 0.036 | 0.92 – 0.99 |
| Silicone rubber, without filler | 0.043 | 1.2 |
| Cast iron, gray | 0.274 | 7.6 |
| Steel | 0.280 | 7.75 |

### Friction Coefficients

| Materials | $\mu$ |
|---|---|
| Steel on Steel (greased) | ~ 0.15 |
| Plastic on Steel | ~ 0.15 – 0.25 |
| Copper on Steel | ~ 0.30 |
| Brass on Steel | ~ 0.35 |
| Aluminum on Steel | ~ 0.45 |
| Steel on Steel | ~ 0.58 |

| Mechanism | $\mu$ |
|---|---|
| Ball Bushings | < 0.001 |
| Linear Bearings | < 0.001 |
| Dove-tail slides | ~ 0.2 ++ |
| Gibb Ways | ~ 0.5 ++ |

## Important Note

The technical data is intended for general information.

Please note the operating instructions and the references indicated on the products for installation, operation and maintenance.

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The technical data, dimensions and weights are subject to change unless otherwise stated on the individual pages of this catalog.

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We reserve the right to adjust the prices and shall charge the prices applying on the date of delivery.

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